

# PROJECT MANUAL

## Performing Arts Center Addition to Crandall High School Crandall, Texas

**July 25, 2024**

**Issue for Bid and Permit**

### **Owner**

Crandall Independent School District  
Contact: Dr. Anjanette Murry, Superintendent

### **Owner's Representative**

Strohmeier Architects, Inc.  
2701 Sunset Ridge Drive, Suite 601  
Rockwall, Texas 75032  
Contact: Jimmy Strohmeier, AIA, NCARB  
Telephone: 469-516-7549  
Electronic Mail: jimmy@strohmeierarchitects.com

### **Construction Manager**

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3501 Token Drive, Suite 100  
Richardson, Texas 75082  
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Telephone: 972-633-0564  
Electronic Mail: jason@gallaghertx.com

### **Architect**

DLR Group  
2500 Pacific Avenue, Suite 1600  
Dallas, Texas 75226  
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Electronic Mail: grademacher@dlrgroup.com

### **Civil Engineer**

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825 Watter Creek Boulevard, Suite M300  
Allen, Texas 75013  
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Telephone: 214-461-9867

**Structural Engineer**

DLR Group  
2500 Pacific Avenue, Suite 1600  
Dallas, Texas 75226  
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**Mechanical, Electrical and Plumbing Engineers**

DLR Group  
2500 Pacific Avenue, Suite 1600  
Dallas, Texas 75226  
Contact: Brent Howard, Mechanical  
Mark Niechwiadowicz, Electrical  
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402-972-4624  
Electronic Mail: bhoward@dlrgroup.com  
mniechwiadowicz@dlrgroup.com

**DLR Group Project Number:**

**39-23712-00**

**END OF DOCUMENT**

**DOCUMENT 00 01 07**

**PROFESSIONAL SEALS PAGE**

The specification sections listed below were prepared by or under the direct supervision of the Architect:

DLR Group  
2500 Pacific Avenue, Suite 1600  
Dallas, Texas 25226

SEAL



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- 01 22 00 Unit Prices
- 01 25 00 Substitution Procedures
  - Substitution Request Form
- 01 26 00 Contract Modification Procedures
- 01 29 00 Payment Procedures
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- 01 32 00 Construction Progress Documentation
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- 01 56 39 Temporary Tree and Plant Protection
- 01 57 13 Erosion and Sedimentation Control
- 01 60 00 Product Requirements
- 01 73 00 Execution
- 01 77 00 Closeout Procedures
- 01 78 23 Operation and Maintenance Data
- 01 78 39 Project Record Documents
- 01 79 00 Demonstration and Training

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- 02 41 19 Selective Demolition

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- 03 30 35 Under Slab Sheet Vapor Retarder
- 03 35 43 Polished Concrete Finishing
- 03 54 16 Hydraulic Cement Underlayment

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- 04 20 00 Unit Masonry

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- 05 40 00 Cold-Formed Metal Framing
- 05 50 00 Metal Fabrications
- 05 51 13 Metal Pan Stairs
- 05 52 13 Pipe and Tube Railings
- 05 58 13 Column Covers
- 05 73 01 Decorative Metal Railings
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- 06 10 53 Miscellaneous Rough Carpentry
- 06 16 36 Wood Panel Product Sheathing
- 06 16 43 Gypsum Sheathing
- 06 41 16 Plastic-Laminate-Clad Architectural Cabinets
- 06 46 00 Wood Trim
- 06 64 00 Plastic Paneling

**DIVISION 07 – THERMAL AND MOISTURE PROTECTION**

- 07 14 00 Elevator Pit Waterproofing
- 07 21 00 Thermal Insulation
- 07 27 26 Fluid-Applied Membrane Air Barriers
- 07 42 13.13 Formed Metal Wall Panels
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- 07 62 00 Sheet Metal Flashing and Trim
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- 07 72 00 Roof Accessories
- 07 81 00 Applied Fireproofing
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- 07 84 43 Joint Firestopping
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- 07 92 00 Joint Sealants
- 07 92 19 Acoustical Joint Sealants
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- 08 11 13 Hollow Metal Doors and Frames
- 08 14 16 Flush Wood Doors
- 08 31 13 Access Doors and Frames
- 08 33 23 Overhead Coiling Doors
- 08 34 73.13 Metal Sound Control Door Assemblies
- 08 41 13 Aluminum-Framed Entrances and Storefronts
- 08 51 13 Aluminum Windows
- 08 62 50 Tubular Day Lighting Device
- 08 71 00 Door Hardware
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- 08 71 13 Automatic Door Operators
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- 09 29 00 Gypsum Board
- 09 30 13 Ceramic Tiling
- 09 51 13 Acoustical Panel Ceilings
- 09 54 26 Linear Wood Ceiling Panels
- 09 61 16 Concrete Floor Sealing
- 09 64 00 Wood Flooring
- 09 64 34 Hardboard Stage Flooring
- 09 65 13 Resilient Base and Accessories
- 09 65 16 Resilient Sheet Flooring
- 09 65 19 Resilient Tile Flooring
- 09 65 43 Linoleum Flooring
- 09 66 23 Resinous Matrix Terrazzo Flooring

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09 68 13 Tile Carpeting  
09 72 00 Wall Coverings  
09 81 16 Acoustical Blanket Insulation  
09 84 15 Cementitious Wood Fiber Acoustical Panels  
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09 91 13 Exterior Painting  
09 91 23 Interior Painting  
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10 11 00 Visual Display Units  
10 12 00 Display Cases  
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10 14 16 Plaques  
10 14 19 Dimensional Letter Signage  
10 18 51 Shower Pans  
10 21 13.17 Phenolic-Core Toilet Compartments  
10 26 00 Wall and Door Protection  
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10 41 00 Fire Department Access Lock and Vault  
10 43 13 Emergency Aid Cabinets  
10 44 13 Fire Protection Cabinets  
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11 13 13 Loading Dock Bumpers  
11 13 19 Stationary Loading Dock Equipment

**DIVISION 12 – FURNISHINGS**

12 35 51 Music Instrument Storage Casework  
12 36 23.13 Plastic-Laminate-Clad Countertops  
12 36 61.16 Solid Surfacing Countertops  
12 36 61.19 Quartz Agglomerate Countertops

**DIVISION 14 – CONVEYING EQUIPMENT**

14 21 23.16 Machine-Room-Less Electric Traction Passenger Elevators

**DIVISION 31 - EARTHWORK**

31 31 16 Termite Control

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**DOCUMENT 00 01 07**

**PROFESSIONAL SEALS PAGE**

The specification sections listed below were prepared by or under the direct supervision of the Structural Engineer:

DLR Group  
2500 Pacific Avenue, Suite 1600  
Dallas, Texas 75226

**DIVISION 03 – CONCRETE**

03 30 00 Cast-in-place Concrete

**DIVISION 05 – METALS**

05 12 00 Structural Steel Framing

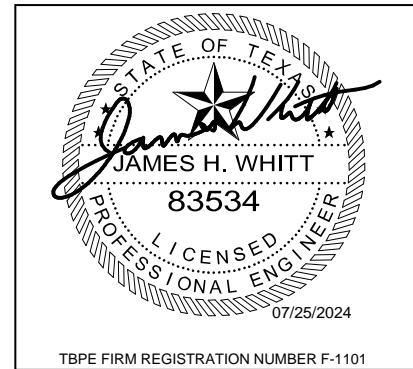
05 21 00 Steel Joist Framing

05 31 00 Steel Decking

**DIVISION 31 – EARTHWORK**

31 63 29 Drilled Concrete Piers and Shafts

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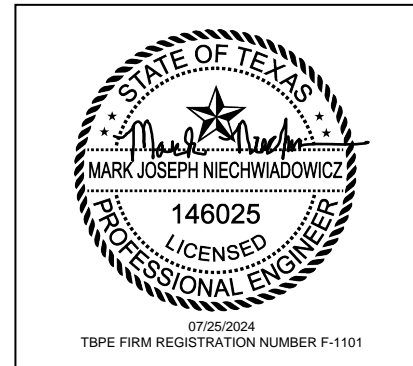
**DOCUMENT 00 01 07**

**PROFESSIONAL SEALS PAGE**

The specification sections listed below were prepared by or under the direct supervision of the Electrical Engineer:

DLR Group  
2500 Pacific Ave Suite 1600  
Dallas, TX 75226

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**DIVISION 26 – ELECTRICAL**

- 26 05 00 Common Work Results for Electrical
- 26 05 03 Demolition of Electrical Systems
- 26 05 19 Low-Voltage Electrical Power Conductors and Cables
- 26 05 26 Grounding and Bonding for Electrical Systems
- 26 05 29 Hangers and Supports for Electrical Systems
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- 26 24 13 Switchboards
- 26 24 16 Panelboards
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- 26 33 23 Central Battery Equipment for Emergency Lighting
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- 27 05 00 Common Work Results for Communications
- 27 05 28 Pathways for Communications Systems
- 27 11 00 Communications Equipment Room Fittings
- 27 13 00 Communication Backbone Cabling
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- 27 51 24 Educational Intercom and Program Systems

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

- 28 05 00 Common Work Results for Electronic Safety and Security
- 28 05 13 Conductors and Cables for Electronic Safety and Security
- 28 46 00 Fire Detection and Alarm Systems

**END OF DOCUMENT**

**DOCUMENT 00 01 07**

**PROFESSIONAL SEALS PAGE**

The specification sections listed below were prepared by or under the direct supervision of the Civil Engineer:

Teague, Nall, and Perkins, Inc.  
825 Watters Creek Blvd, Suite M300  
Allen, TX 75013

SEAL

**DIVISION 01 – GENERAL REQUIREMENTS**

01 57 23 Temporary Storm Water Pollution Control

**DIVISION 31 – EARTHWORK**

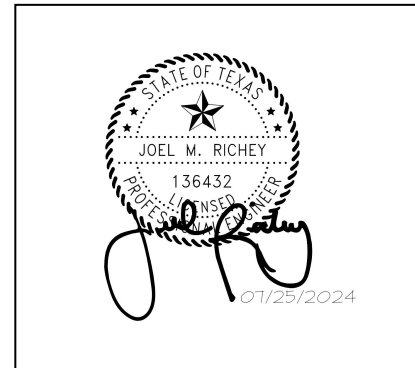
31 00 00 Earthwork  
31 10 00 Site Clearing  
31 23 33 Trenching and Backfilling  
31 32 00 Soil Stabilization

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 13 13 Concrete Paving  
32 17 23 Pavement Markings  
32 19 00 Walk Road and Parking Appurtenances

**DIVISION 33 – UTILITIES**

33 30 00 Sanitary Sewerage Utilities  
33 40 00 Storm Drainage Utilities



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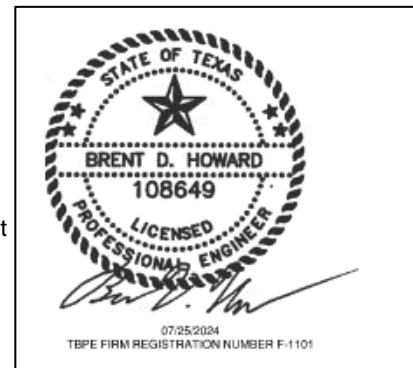
**DOCUMENT 00 01 07**

**PROFESSIONAL SEALS PAGE**

The specification sections listed below were prepared by or under the direct supervision of the Mechanical Engineer:

DLR Group  
2500 Pacific Ave Ste. 1600  
Dallas, TX 75226

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**DIVISION 21 – FIRE SUPPRESSION**

- 21 05 00 Common Work Results for Fire Suppression
- 21 05 23 General-Duty Valves for Water-Based Fire-Suppression Piping
- 21 05 29 Hangers and Supports for Fire-Suppression Piping and Equipment
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- 22 05 00 Common Work Results for Plumbing
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- 22 05 29 Hangers and Supports for Plumbing Piping and Equipment
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- 22 13 16 Sanitary Waste and Vent Piping
- 22 14 13 Storm Drainage Piping
- 22 14 29 Sump Pumps
- 22 33 00 Electric, Domestic Water Heaters
- 22 42 00 Commercial Plumbing Fixtures
- 22 47 13 Drinking Fountains

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- 23 05 29 Hangers and Supports for HVAC Piping and Equipment
- 23 05 53 Identification for HVAC Piping and Equipment
- 23 05 93 Testing, Adjusting, and Balancing for HVAC
- 23 07 13 Duct Insulation
- 23 09 23 Energy Management Control System
- 23 09 23.1 Sequence of Operations
- 23 11 23 Facility Natural Gas Piping
- 23 22 13 Steam and Condensate Piping
- 23 23 00 Refrigerant Piping
- 23 31 13 Metal Ducts
- 23 33 00 Air Duct Accessories
- 23 33 46 Flexible Ducts
- 23 34 00 HVAC Fans
- 23 36 00 Air Terminal Units
- 23 37 13.13 Air Diffusers
- 23 37 13.23 Registers and Grilles
- 23 73 43.16 Outdoor, Semi-Custom Air-Handling Units
- 23 81 26 Split-System Air Conditioners
- 23 83 13.29 Self-contained Steam Humidifiers

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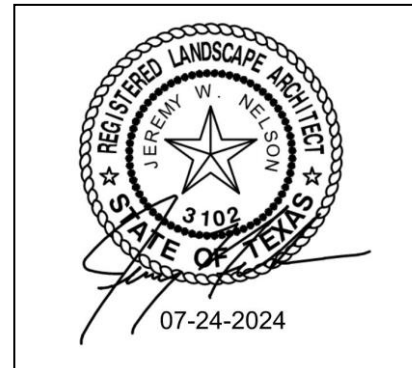
The specification sections listed below were prepared by or under the direct supervision of the Landscape Architect:

Teague, Nall, and Perkins, Inc.  
825 Watters Creek Blvd, Suite M300  
Allen, TX 75013

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

- 32 84 00 Planting Irrigation
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06 41 16	Plastic-Laminate-Clad Architectural Cabinets .....	25 Jul 24	
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10 21 13.17	Phenolic-Core Toilet Compartments .....	25 Jul 24	
10 26 00	Wall and Door Protection.....	25 Jul 24	
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21 05 53	Identification for Fire-Suppression Piping and Equipment.....	25 Jul 24	
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22 05 29	Hangers and Supports for Plumbing Piping and Equipment.....	25 Jul 24	
22 05 53	Identification for Plumbing Piping and Equipment .....	25 Jul 24	
22 07 19	Plumbing Piping Insulation .....	25 Jul 24	
22 11 16	Domestic Water Piping.....	25 Jul 24	
22 11 19	Domestic Water Piping Specialties.....	25 Jul 24	
22 13 16	Sanitary Waste and Vent Piping.....	25 Jul 24	
22 14 13	Storm Drainage Piping .....	25 Jul 24	
22 14 29	Sump Pumps.....	25 Jul 24	
22 33 00	Electric, Domestic-Water Heaters .....	25 Jul 24	
22 42 00	Commercial Plumbing Fixtures.....	25 Jul 24	
22 47 00	Drinking Fountains .....	25 Jul 24	

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26 05 03	Demolition of Electrical Systems .....	25 Jul 24	
26 05 19	Low-Voltage Electrical Power Conductors and Cables .....	25 Jul 24	
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26 09 23	Lighting Control Systems and Devices.....	25 Jul 24	
26 22 13	Low-Voltage Distribution Transformers .....	25 Jul 24	
26 24 13	Switchboards.....	25 Jul 24	
26 24 16	Panelboards .....	25 Jul 24	
26 27 26	Wiring Devices .....	25 Jul 24	
26 28 13	Fuses .....	25 Jul 24	
26 28 16	Disconnect Switches .....	25 Jul 24	
26 28 17	Company Switches.....	25 Jul 24	
26 29 13	Full Voltage Motor Controllers .....	25 Jul 24	
26 33 23	Central Battery Equipment for Emergency Lighting.....	25 Jul 24	
26 41 13	Lightning Protection for Structures .....	25 Jul 24	
26 51 00	Lighting .....	25 Jul 24	
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27 05 00	Common Work Results for Communications.....	25 Jul 24	
27 05 28	Pathways for Communications Systems .....	25 Jul 24	
27 11 00	Communications Equipment Room Fittings.....	25 Jul 24	
27 13 00	Communications Backbone Cabling.....	25 Jul 24	
27 15 00	Communications Horizontal Cabling .....	25 Jul 24	
27 41 16	Integrated Audiovisual Systems .....	25 Jul 24	
27 51 24	Educational Intercom and Program Systems .....	25 Jul 24	
<b>DIVISION 28 – ELECTRONIC SAFETY AND SECURITY</b>			
28 05 00	Common Work Results for Electronic Safety and Security.....	25 Jul 24	
28 05 13	Conductors and Cables for Electronic Safety and Security .....	25 Jul 24	
28 46 00	Fire Alarm Systems .....	25 Jul 24	
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<b>DIVISION 31 – EARTHWORK</b>			
31 00 00	Earthwork (C) .....	25 Jul 24	
31 10 00	Site Clearing (C).....	25 Jul 24	
31 23 33	Trenching and Backfilling (C) .....	25 Jul 24	
31 31 16	Termite Control.....	25 Jul 24	
31 32 00	Soil Stabilization (C) .....	25 Jul 24	
31 63 29	Drilled Concrete Piers and Shafts (S).....	25 Jul 24	
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32 13 13	Concrete Paving (C).....	25 Jul 24	
32 17 23	Pavement Markings (C).....	25 Jul 24	
32 19 00	Walk Road and Parking Appurtenances (C).....	25 Jul 24	
32 84 00	Planting Irrigation (LA).....	25 Jul 24	
32 92 13	Hydromulching (LA).....	25 Jul 24	
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## DOCUMENT 00 26 00

### PROCUREMENT SUBSTITUTION PROCEDURES

#### 1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 25 00 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

#### 1.2 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
  - 1. Extensive revisions to the Contract Documents are not required.
  - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
  - 3. The request is fully documented and properly submitted.

#### 1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:
  - 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
  - 2. Submittal Format: Submit three copies of each written Procurement Substitution Request, using form bound in Project Manual.
  - 3. Submittal Format: Submit Procurement Substitution Request, using format provided on Project Web site.
    - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
    - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
      - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
      - 2) Copies of current, independent third-party test data of salient product or system characteristics.
      - 3) Samples where applicable or when requested by Architect.
      - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
      - 6) Research reports, where applicable, evidencing compliance with building code in effect for Project, from ICC-ES.

- 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
  - c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
  - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
- B. Architect's Action:
  - 1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

**END OF DOCUMENT**

**PROCUREMENT SUBSTITUTION REQUEST FORM**

PROJECT: \_\_\_\_\_ **(Before Contract Award)**  
TO: \_\_\_\_\_  
NO. \_\_\_\_\_ DATE: \_\_\_\_\_

Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Division 01 Section "Substitution Procedures:"

**1. SPECIFIED PRODUCT OR SYSTEM**

Substitution request for: \_\_\_\_\_

Specification Section No.: \_\_\_\_\_ Article/ Paragraph: \_\_\_\_\_

**2. REASON FOR SUBSTITUTION REQUEST**

SPECIFIED PRODUCT . . .

PROPOSED PRODUCT . . .

- |  |   |
|--|---|
| <input type="checkbox"/> Is no longer available.                                 | <input type="checkbox"/> Will reduce construction time                      |
| <input type="checkbox"/> Is unable to meet project schedule.                     | <input type="checkbox"/> Will result in cost savings of \$ _____ to Project |
| <input type="checkbox"/> Is unsuitable for the designated application.           | <input type="checkbox"/> Is for supplier's convenience                      |
| <input type="checkbox"/> Cannot interface with adjacent materials.               | <input type="checkbox"/> Is for subcontractor's convenience                 |
| <input type="checkbox"/> Is not compatible with adjacent materials.              | <input type="checkbox"/> Other: _____                                       |
| <input type="checkbox"/> Cannot provide the specified warranty.                  |   |
| <input type="checkbox"/> Cannot be constructed as indicated                      |   |
| <input type="checkbox"/> Cannot be obtained due to one or more of the following: |   |
| <input type="checkbox"/> Strike  | <input type="checkbox"/> Bankruptcy of manufacturer or supplier             |
| <input type="checkbox"/> Lockout   | <input type="checkbox"/> Similar occurrence (explain below)                 |

**3. SUPPORTING DATA**

- Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request are attached.
- Sample is attached.  Sample will be sent if requested.

**4. QUALITY COMPARISON:** Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

	SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer:	_____	_____
Name / Brand:	_____	_____
Catalog No.:	_____	_____
Vendor:	_____	_____
Variations:	_____	_____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: \_\_\_\_\_  
Maintenance Service Available:  Yes  No  
Spare Parts Source: \_\_\_\_\_  
Warranty:  Yes  No \_\_\_\_\_ Years

**5. PREVIOUS INSTALLATIONS**

Identification of at least three similar projects on which proposed substitution was used:

PROJECT #1: \_\_\_\_\_  
Address: \_\_\_\_\_  
Architect: \_\_\_\_\_  
Owner: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

PROJECT #2: \_\_\_\_\_  
Address: \_\_\_\_\_  
Architect: \_\_\_\_\_  
Owner: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

PROJECT #3: \_\_\_\_\_  
Address: \_\_\_\_\_  
Architect: \_\_\_\_\_  
Owner: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

**6. EFFECT OF SUBSTITUTION**

Proposed substitution affects other work or trades:  No  Yes (if Yes, explain)  
\_\_\_\_\_  
\_\_\_\_\_

Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:  No  Yes (if Yes, attach data explaining revisions)

**7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS**

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

- A. They have personally investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated above;
- B. The proposed substitution is in compliance with applicable codes and ordinances;
- C. The proposed substitution will provide same warranty as specified for specified product;
- D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;
- E. They have included complete cost data and implications of the substitution (attached);
- F. They will pay any redesign fees incurred by the Architect or any of the Architect's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;
- G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.
- H. The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Contractor: \_\_\_\_\_  
*(Name of Contractor)*



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

Subcontractor: \_\_\_\_\_

(Name of Subcontractor)

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

**Note: Unresponsive or incomplete requests will be rejected and returned without review.**

**8. ARCHITECT'S REVIEW AND ACTION**

Substitution is accepted.

Substitution is accepted, with the following comments: \_\_\_\_\_

Resubmit Substitution Request:

Provide more information in the following areas: \_\_\_\_\_

- Provide proposal indicating amount of savings / credit to Owner
- Bidding Contractor shall sign Bidder's Statement of Conformance
- Bidding Subcontractor shall sign Bidder's Statement of Conformance

Substitution is not accepted:

- Substitution Request received too late.
- Substitution Request received directly from subcontractor or supplier.
- Substitution Request not submitted in accordance with requirements.
- Substitution Request Form is not properly executed.
- Substitution Request does not indicate what item is being proposed.
- Insufficient information submitted to facilitate proper evaluation.
- Proposed product does not appear to comply with specified requirements.
- Proposed product will require substantial revisions to Contract Documents.

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

Architect has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

**END OF FORM**

**DOCUMENT 00 31 32**

**GEOTECHNICAL DATA**

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. A geotechnical investigation report for Project, prepared by Alpha Testing, LLC; Report No. G240443, dated April 19, 2024, is available for viewing as appended to this Document.
  - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
  - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

**END OF DOCUMENT**



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**GEOTECHNICAL EXPLORATION**

**PERFORMING ARTS CENTER  
CRANDALL HIGH SCHOOL**

13385 F.M. 3039

Crandall, Texas

ALPHA Report No. G240443

April 19, 2024

Prepared for:

**CRANDALL ISD**

P.O. Box 128

Crandall, Texas 75114

Attention: Mr. Scott Stewart

Prepared By:

**ALPHA  TESTING**

A Universal Engineering Sciences Company

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April 19, 2024

**Crandall ISD**  
P.O. Box 128  
Crandall, Texas 75114

Attention: Mr. Scott Stewart

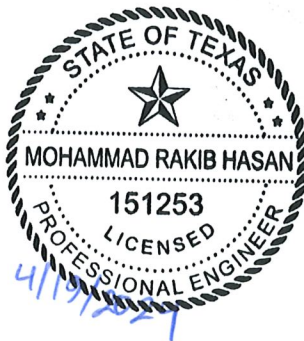
Re: Geotechnical Exploration  
**Performing Arts Center**  
**Crandall High School**  
13385 F.M. 3039  
Crandall, Texas  
ALPHA Report No. G240443

Attached is the report of the geotechnical exploration performed for the referenced project. This study was authorized by Mr. Scott Stewart on February 9, 2024 and was performed in accordance with ALPHA Proposal No. 102893 dated February 7, 2024.

This report contains results of field explorations and laboratory testing and an engineering interpretation of these with respect to available project characteristics. The results and analyses were used to develop recommendations to aid design and construction of foundations and pavement.

ALPHA TESTING, LLC. appreciates the opportunity to be of service on this project. If we can be of further assistance, such as providing materials testing services during construction, please contact our office.

Sincerely,

**ALPHA TESTING, LLC.**Md. Rakib Hasan, PhD, P.E.  
Senior Geotechnical Engineer , P.E.Harsha R. Addula, P.E.  
Associate Principal



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#### APPENDIX

A-1	Methods of Field Exploration Boring Location Plan – Figure 1
B-1	Methods of Laboratory Testing Log of Borings Key to Soil Symbols and Classifications

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## **1.0 PURPOSE AND SCOPE**

The purpose of this geotechnical exploration is for ALPHA TESTING, LLC. (ALPHA) to evaluate for Crandall ISD (Client) some of the physical and engineering properties of subsurface materials at selected locations on the subject site with respect to formulation of appropriate geotechnical design parameters for the foundation design of proposed construction. The field exploration was accomplished by securing subsurface samples from widely spaced test borings performed across the expanse of the site. Engineering analyses were performed from results of the field exploration and results of laboratory tests performed on representative samples.

Also included are general comments pertaining to reasonably anticipated construction problems and recommendations concerning earthwork and quality control testing during construction. This information can be used to evaluate subsurface conditions and to aid in ascertaining construction meets project specifications.

Recommendations provided in this report were developed from information obtained in test borings depicting subsurface conditions only at the specific test boring locations and at the particular time designated on the Log of Boring Sheets (i.e., boring logs). Subsurface conditions at other locations may differ from those observed at the test boring locations, and subsurface conditions at test boring locations may vary at different times of the year. The scope of work may not fully define the variability of subsurface materials and conditions that are present on the site.

The nature and extent of variations between test borings may not become evident until construction. If significant variations then appear evident, our office should be contacted to re-evaluate our recommendations after performing on-site observations and possibly other tests.

## **2.0 PROJECT CHARACTERISTICS**

The project site is located at 13385 F.M. 3039 in Crandall, Texas. A site plan illustrating the general outline of the property, with ALPHA's boring locations noted on it, is provided as Boring Location Plan – Figure 1, attached in the Appendix. At the time the field exploration was performed, the area for the proposed performing arts addition consisted of an open field covered with grass adjacent to the existing high school building and associated pavement. Based on visual observation, the site was relatively level.

Present plans provide for the construction of a 1- to 2-story performance arts addition to the existing high school building and associated new site paving. The proposed building will cover a plan area of about 25,000 SF. We understand that maximum foundation loads could be 250 to 300 kips. It is anticipated the addition will be supported using a drilled pier foundation system with a structurally supported floor system. It is anticipated area pavement will consist of portland cement concrete (PCC).

A grading plan was not available at the time of this geotechnical exploration. For the purposes of this study, we have assumed cuts and fills utilized to establish final grades in the building pad areas will be limited to 2 ft or less.



### **3.0 FIELD EXPLORATION**

Using standard rotary drilling equipment, subsurface conditions on site were explored by drilling five (5) widely spaced test borings in general accordance with ASTM D 420. The corresponding location and depth of each boring are provided in Table A.

<b>TABLE A</b>		
<b>Planned Construction</b>	<b>Boring No.</b>	<b>Boring Depth, ft</b>
Proposed Building Addition	1, 2, 3, and 4	65 to 75
Pavement and Drives	5	5

The approximate location of each test boring is shown on the Boring Location Plan – Figure 1, enclosed in the Appendix. Details of drilling and sampling operations are briefly summarized in Methods of Field Exploration, Section A-1 of the Appendix.

Subsurface types encountered during the field exploration are presented on Log of Boring sheets (boring logs), included in the Appendix. The boring logs contain our Field Technician's and Engineer's interpretation of conditions believed to exist between actual samples retrieved. Therefore, these boring logs contain both factual and interpretive information. Lines delineating subsurface strata on the boring logs are approximate and the actual transition between strata may be gradual.

### **4.0 LABORATORY TESTS**

Selected samples of the subsurface materials were tested in the laboratory to evaluate their engineering properties as a basis in providing recommendations for foundation design and earthwork construction. A brief description of testing procedures used in the laboratory can be found in Methods of Laboratory Testing, Section B-1 of the Appendix. Individual test results are presented on Log of Boring sheets or on summary data sheets also enclosed in the Appendix.

### **5.0 GENERAL SUBSURFACE CONDITIONS**

Based on the Geologic Atlas of Texas (Dallas Sheet) from the Texas Bureau of Economic Geology, published by the University of Texas at Austin, and the subsurface materials encountered in the test borings, the project site appears to lie within the undivided formation of Neylandville Marl and Marlbrook Marl near alluvial and fluvial terrace deposits. The Neylandville Marl is composed of light gray to dark gray clay and calcareous clay. The Marlbrook Marl is composed of blocky structured clays, marl with disseminated pyrite, phosphate nodules, coloration varies from light to dark gray; weathers light gray. Clays associated with this formation are generally considered to be highly plastic. The alluvium and fluvial Terrace deposits include gravel, sand, silt, and clay in varying proportions.



Within the 75-ft maximum depth explored on the site, subsurface materials consist generally of clay (CH/CL), sandy clay (CL), and sand (SP/SM) underlain by gray marl extended to the boring termination depths. Gray marl was encountered in Borings 1, 2, 3, and 4 at depths of about 57 to 58 ft below existing grade. Boring 5 was terminated in clay at 5 ft below existing grade. Concrete pavement with 5 inches thickness over 2-inch base material was encountered at the surface of Boring 5. The letters in parenthesis represent the soils' classification according to the Unified Soil Classification System (ASTM D 2487). More detailed stratigraphic information is presented on the Log of Borings, attached in the Appendix.

Groundwater was encountered at depths of about 35 to 37 ft below existing grade while drilling Borings 1, 2, 3, and 4. Groundwater was measured in the open bore holes at depths of about 35 to 40 ft in Borings 1, 2, 3, and 4, upon drilling completion. Groundwater was not encountered in Boring 5. These groundwater observations provide an indication of the groundwater conditions present at the time the borings were drilled. The granular soils (sand) encountered in the borings are considered relatively permeable. However, the clay and marl subsurface materials are considered relatively impermeable and are anticipated to have a slow response to water movement. Therefore, several days of observation will be required to evaluate actual groundwater levels within the depths explored. Also, the groundwater level at the site is anticipated to fluctuate seasonally depending on the amount of rainfall, prevailing weather conditions and subsurface drainage characteristics. It is common to detect shallower seasonal groundwater within the clayey matrix, in the granular soils, near the soil/rock (marl) interface or from fractures in the rock, particularly during or after periods of precipitation. If more detailed groundwater information is required, monitoring wells or piezometers can be installed.

Further details concerning subsurface materials and conditions encountered can be obtained from the Log of Borings, included in the Appendix.

## **6.0 DESIGN RECOMMENDATIONS**

The following design recommendations were developed on the basis of the previously described Project Characteristics (Section 2.0) and General Subsurface Conditions (Section 5.0). If project criteria change, including location of the proposed building, our office should conduct a review to determine if modifications to the recommendations are required. Further, it is recommended our office be provided with a copy of the final building plans and specifications for review prior to construction.

The following design criteria given were developed assuming the final grades are established within 2 ft of existing grade using on-site or similar imported fill material. Additional cutting and filling on the site other than assumed might require modifications to the recommendations provided. Therefore, if changes to the project plans and specifications are made our office must be contacted to verify the appropriate recommendations and design parameters are utilized for the project.

Differential movements can occur between the existing structure and the proposed addition. Methods should be implemented to allow for possible differential performance between the foundation systems of the existing structure and the addition. Preventative measures should also be taken in order not to damage the integrity of the existing foundation system and flatwork during construction of the addition.





## 6.1 Drilled Straight-Shaft Pier Foundation System

The proposed performing arts center addition could be supported using a system of drilled, straight-shaft piers bearing in gray marl. The gray marl was encountered at the depths of about 57 to 58 ft below existing grades in Borings 1, 2, 3, and 4. These piers should bear at least 3 ft into the underlying gray marl. Deeper penetrations will be required to develop skin friction and/or uplift resistance.

Groundwater was encountered at depths of about 35 to 37 ft below existing grade in Borings 1, 2, 3, and 4 while drilling. Casing of piers may be needed to control groundwater seepage and caving of soils.

Based on the conditions encountered in the borings, the design values in Table B are recommended for design of drilled, straight-shaft pier foundation.

<b>TABLE B</b>			
<b>Net Allowable End Bearing and Skin Friction Values</b>			
<b>Material</b>	<b>Net Allowable End Bearing (ksf)</b>	<b>Skin Friction<sup>1</sup> (ksf)</b>	<b>Allowable Uplift Skin Friction<sup>1</sup> (ksf)</b>
Properly Compacted Fill and Native Clay to a Depth of 20 ft Below Final Grade	Not Applicable	Neglect	Neglect
Clay at Least 20 ft Below Final Grade, Sandy Clay, Sand, and Upper 3 ft of Gray Marl	Not Applicable	0.3	0.2
At Least 3 ft Below the Surface of Gray Marl	20.0 <sup>2</sup>	4.0	3.2
<sup>1</sup> The skin friction values provided for the marl are applicable for the portion of the shaft below the bottom of any temporary casing used. <sup>2</sup> The test borings for this project extended to a maximum depth of 75 feet below the existing ground surface. Drilled piers utilizing end bearing to derive part of their capacity should not be drilled deeper than 70 ft below the existing ground surface. Piers drilled to depths of 70 ft or deeper should consider skin friction resistance only. Deeper test borings will be required to utilize end bearing resistance below a depth of 70 feet.			

The minimum clear spacing between piers should be at least two (2) pier shaft diameters (based on the larger diameter pier) to develop the full load carrying capacity from skin friction. Closer spacing will result in reduced skin friction resistance. The skin friction will vary linearly from the full value at a clear spacing of 2 diameters to 50 percent of the design value with no clear spacing. The allowable bearing capacity provided in Table B contains a factor of safety of at least 3 considering a general bearing capacity failure and the skin friction values and the allowable uplift skin friction values have a factor of safety of at least 2. Normal elastic settlement of piers under loading is estimated at less than about 1 inch.

Each pier should be designed with sufficient full-length reinforcing steel and a sufficient embedment into the gray marl to resist the uplift pressure (soil-to-pier adhesion) due to potential soil swell along the shaft from post construction heave and other uplift forces applied by structural loadings. The magnitude of uplift adhesion due to soil swell along the pier shaft cannot be defined accurately and can vary according to the actual in-place moisture content of the soils during



construction. It is estimated this uplift adhesion will not exceed about 2.0 ksf. This soil adhesion is approximated to act uniformly over the portion of the shaft situated within 12 ft of finished exterior grades.

All grade beams connecting piers and pier caps should be formed and not cast in earthen trenches. Grade beams/pier caps should be formed with a nominal 12-inch void at the bottom. Commercially available cardboard box forms (cartons) are made for this purpose. The cardboard cartons should extend the full length and width of the grade beams/pier caps. Prior to concrete placement, cartons should be inspected to verify they are firm, properly placed, and capable of supporting wet concrete. Some type of permanent soil retainer, such as pre-cast concrete panels, must be provided to prevent soils adjacent to grade beams/pier caps from sloughing into the void space at the bottom of the grade beams. Additionally, backfill soils (on-site clay soils used for general fill) placed adjacent to grade beams/pier caps must be compacted as outlined in Section 7.3.

Lateral analysis for drilled piers constructed at the site can be performed using the following design parameters (L-Pile) provided for the site soils in Table C.

<b>Material</b>	<b>Native Clay Soils<sup>1</sup>, Sandy Clay, and Upper 3 ft of Gray Marl</b>	<b>Sand</b>	<b>Gray Marl (At least 3 ft of Penetration)</b>
L-Pile p-y Model	Stiff clay	Sand (Reese)	Weak rock
Effective Unit Weight ( $\gamma$ ), pci	0.069	0.076	0.078
Undrained Cohesion (c), psi	5.2	-	-
Friction Angle, degrees	-	30	-
Rock Uniaxial Compressive Strength ( $q_u$ ), psi	-	-	160
Rock Mass Modulus ( $E_r$ ), psi	-	-	16,000
Rock Quality Designation (RQD) <sup>2</sup> , %	-	-	70-90
Rock Strain Factor ( $k_{rm}$ )	-	-	0.0001
<sup>1</sup> The upper 6 ft of soil should be neglected due to soil disturbance and seasonal moisture changes. <sup>2</sup> Rock Quality Designation (RQD) is based on our area experience and the results of the field exploration.			

## **6.2 Floor System for Pier Supported Structure**

Considering the subsurface conditions encountered at this site, and our experience in the site area, grade-supported slabs, pavement and flatwork could experience soil-related movements on the order of 4 to 6 inches. The potential movements were estimated using results of absorption swell tests, in general accordance with methods outlined by TxDOT Test Method Tex-124-E and engineering judgment and experience. Estimated movements were calculated assuming the moisture content of the in-situ soil within the normal zone of seasonal moisture content change varies between a “dry” condition and a “wet” condition as defined by Tex-124-E. Also, it was



assumed a 1 psi surcharge load from the slab acts on the subgrade soils. Movements exceeding those predicted could occur if positive drainage of surface water is not maintained or if soils are subject to an outside water source, such as leakage from a utility line or subsurface moisture migration from off-site locations.

We recommend a floor system that is suspended completely above the existing highly expansive soils. A minimum 12-inch void space should be provided between the bottom of the slab (and the lowest suspended fixture/utility) and top surface of the underlying expansive clays. Cardboard or plastic void boxes can be used to create the minimum void space. Provisions should be made for differential movement of utility lines, including areas where the utility penetrates through the grade beam.

### **6.3 Flatwork**

Flatwork will be subjected to potential seasonal movements as described in Section 6.2 (on the order of 4 to 6 inches). In areas where flatwork movement is critical (such as, but not limited to, main entrances), flatwork should be structurally supported as discussed in Sections 6.1 and 6.2. As an alternative, subgrade improvement consisting of moisture conditioning or chemical injection could be considered for reduction in soil movements in any areas where post-construction movements would be critical. If desired, our office should be contacted for subgrade improvement recommendations.

### **6.4 Seismic Considerations**

The Site Class for seismic design is based on several factors that include soil profile (soil or rock), shear wave velocity, and strength, averaged over a depth of 100 ft. Since our borings did not extend to 100-foot depths, we based our determinations on the assumption that the subsurface materials below the bottom of the borings were similar to those encountered at the termination depth of the borings. Based on Section 1613.2.2 of the 2018 International Building Code and Table 20.3-1 in the 2010 ASCE-7, we recommend using Site Class C (very dense soil and soft rock) for seismic design at this site.

### **6.5 Area Pavement**

Clay soils encountered near the existing ground surface at the borings will probably constitute the subgrade for most parking and drive areas. Therefore, it is recommended the existing subsurface materials be improved prior to construction as recommended in Section 7.1. A qualified Geotechnical Engineer should be retained to provide subgrade monitoring and testing during construction. If there is any change in project criteria, the recommendations contained in this report should be reviewed by our office.

Calculations used to determine the required pavement thickness are based only on the physical and engineering properties of the materials used and conventional thickness determination procedures. Pavement adjoining the building should be constructed with a curb and the joint between the building and curb should be sealed. Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations, reinforcing steel, joint design, and environmental factors will significantly affect the service life and must be included in preparation of the construction drawings and specifications, but all were not included in the scope



of this study. Normal periodic maintenance will be required for all pavements to achieve the design life of the pavement system.

The recommended pavement sections provided in Section 6.5.2 are considered the minimum necessary to provide satisfactory performance based on the expected traffic loading. In some cases, City minimum standards for pavement section construction may exceed those recommended in Section 6.5.2.

### **6.5.1 Pavement Subgrade Preparation**

Lime treatment of the pavement subgrade is not necessary for pavements subjected *exclusively* to passenger vehicle traffic, although lime treatment in these areas would be generally beneficial to the long-term performance of the pavement and improve constructability. Prior to construction of pavement on untreated clay subgrade soil, the exposed subgrade should be scarified to a depth of at least 6 inches and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of -1 to +3 percentage points of the material's optimum moisture content.

Pavement subgrades in drive lanes, fire lanes, dumpster areas and areas subjected to truck traffic should be lime treated. For estimating purposes, the exposed surface of the pavement subgrade soil should be scarified to a depth of 6 inches and mixed with a minimum of 8 percent hydrated lime (by dry soil weight) in conformance with TxDOT Standard Specifications Item 260. Assuming an in-place unit weight of 100 pcf for the pavement subgrade soils, this percentage of lime equates to about 36 lbs of lime per sq yard of treated subgrade. The actual amount of lime required should be confirmed by additional laboratory tests prior to construction.

It is recommended lime stabilization procedures extend at least 1 ft beyond the edge of the pavement to reduce effects of seasonal shrinking and swelling upon the extreme edges of pavement. The soil-lime mixture should be compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to +4 percentage points of the mixture's optimum moisture content.

The on-site soils can contain a sufficient quantity of soluble sulfates that can adversely react with hydrated lime added during the mechanical lime stabilization process. Therefore, before committing to mechanical lime stabilization, samples of the pavement subgrade soil should be tested for the quantity of soluble sulfates. Our office should be contacted regarding evaluation of the quantity of soluble sulfates detected and any special processing/design features that may be applicable due to the soluble sulfate concentrations measured.

Good perimeter surface drainage with a minimum slope of 2 percent away from the pavement is recommended. The use of sand as a leveling course below pavement supported on expansive clays should be avoided. Normal maintenance of pavement should be expected over the life of the structures.

Mechanical lime treatment of the pavement subgrade soil will not prevent normal seasonal movement of the underlying untreated materials. Pavement and other flatwork will have



the same potential for movement as slabs constructed directly on the existing undisturbed soils (on the order of 4 to 6 inches).

### **6.5.2 Portland Cement Concrete (PCC) Pavement**

Following subgrade preparation as recommended in Section 6.5.1, the following PCC (reinforced) pavement sections are recommended in Table D.

<b>TABLE D Recommended PCC Pavement Sections</b>		
<b>Paving Areas and/or Type</b>	<b>Subgrade Thickness, Inches</b>	<b>PCC Thickness, Inches</b>
Parking Areas Subjected Exclusively to Passenger Vehicle Traffic	Scarified and Compacted, 6	5
Drive Lanes, Fire Lanes, Areas Subject to Light Volume Truck Traffic	Lime Modified, 6	6
Dumpster Traffic Areas	Lime Modified, 6	7

PCC should have a minimum compressive strength of 3,000 psi at 28 days in parking areas subjected exclusively to passenger vehicle traffic. We recommend a minimum compressive strength of 3,500 psi at 28 days for drive lanes, fire lanes, and truck areas. Concrete should be designed with  $4.5 \pm 1.5$  percent entrained air. Joints in concrete paving should not exceed 15 ft. Reinforcing steel should consist of No. 3 bars placed at 18 inches on-center in two directions.

Alternatively, mechanical lime stabilization of the pavement subgrade could be eliminated by increasing the PCC thickness in the pavement sections presented in Table D by 1 inch. Prior to construction of pavement on untreated clay subgrade soil, the exposed subgrade should be scarified to a depth of at least 6 inches and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of -1 to +3 percentage points of the material's optimum moisture content.

### **6.6 Corrosion**

Selected soil samples were tested for electrical resistivity and sulfates. The results of these tests are provided in Table E.

<b>TABLE E Corrosivity Test Results</b>					
<b>Boring No.</b>	<b>Depth, ft</b>	<b>Type of Material</b>	<b>pH</b>	<b>Resistivity, ohm-cm</b>	<b>Soluble Sulfates, ppm</b>
1	2-4	Brown Clay	8.1	6000	<100
3	4-6	Brown Clay	7.9	6000	<100



The electrical resistivity test results indicate moderate corrosion potential for ferrous materials in contact with on-site soils. The soluble sulfate tests are considered to be low, and Type I or Type II portland cement is considered to be adequate for this project.

### **6.7 Drainage and Other Considerations**

Adequate drainage should be provided to reduce seasonal variations in the moisture content of foundation soils. All pavement and sidewalks within 10 ft of the structures should be sloped away from the buildings to prevent ponding of water around the foundation. Final grades within 10 ft of the structures should be adjusted to slope away from the structures at a minimum slope of 2 percent. **Maintaining positive surface drainage throughout the life of the structures is essential.**

In areas with pavement or sidewalks adjacent to the structures, a positive seal must be maintained between the structures and the pavement or sidewalk to minimize seepage of water into the underlying supporting soils. Post-construction movement of pavement and flat-work is common. Normal maintenance should include examination of all joints in paving and sidewalks, etc. as well as re-sealing where necessary.

Several factors relate to civil and architectural design and/or maintenance, which can significantly affect future movements of the foundation and floor slab system:

- Preferably, a complete system of gutters and downspouts should carry runoff water a minimum of 5 feet from the completed structures.
- Large trees and shrubs should not be allowed closer to the foundations than a horizontal distance equal to roughly one-half of their mature height due to their significant moisture demand upon maturing.
- Moisture conditions should be maintained "constant" around the edge of the slabs. Ponding of water in planters, in unpaved areas, and around joints in paving and sidewalks can cause slab movements beyond those predicted in this report.
- Planter box structures placed adjacent to the building should be provided with a means to assure concentrations of water are not available to the subsoil stratigraphy.
- The root systems from previous trees at this site will have dried and desiccated the surrounding clay soils, resulting in soil with near-maximum swell potential. Clay soils surrounding tree root mats in building pad and flatwork areas should be removed to a depth of 3 ft or 1 ft below the root ball, whichever is deeper, and compacted in-place with moisture and density control as described in Section 7.3, as applicable.

Trench backfill for utilities should be properly placed and compacted as outlined in Sections 7.3 and 7.4 and in accordance with requirements of local municipal standards. Since granular bedding backfill is used for most utility lines, the backfilled trench should not become a conduit and allow access for surface or subsurface water to travel toward the structures. Concrete cut-off collars or clay plugs should be provided where utility lines cross building lines to prevent water from traveling in the trench backfill and entering beneath the structures.



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## **7.0 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS**

Variations in subsurface conditions could be encountered during construction. To permit correlation between test boring data and actual subsurface conditions encountered during construction, it is recommended a registered Professional Engineering firm be retained to observe construction procedures and materials.

Some construction problems, particularly degree or magnitude, cannot be reasonably anticipated until the course of construction. The recommendations offered in the following paragraphs are intended not to limit or preclude other conceivable solutions, but rather to provide our observations based on our experience and understanding of the project characteristics and subsurface conditions encountered in the borings.

### **7.1 Site Preparation and Grading**

Site preparation for the proposed project should include removing existing site improvements (i.e. pavements, utilities, etc.), vegetation, topsoil, and any other unsuitable surface materials from the areas of construction. Abandoned utility lines should be either removed or positively sealed to prevent possible water seepage into subgrade soils. Any soil disturbed due to removal of the existing site improvements should be re-compacted in accordance with information provided in Section 7.3, as applicable.

All areas supporting foundation systems, floor slab, flatwork, or areas to receive fill should be properly prepared.

- After completion of the necessary stripping, clearing, and excavating and prior to placing any required fill, the exposed subgrade should be carefully evaluated by probing and testing. Any undesirable material (organic material, wet, soft, or loose soil) still in place should be removed.
- The exposed subgrade should be further evaluated by proof-rolling with a heavy pneumatic tired roller, loaded dump truck or similar equipment weighing approximately 20 tons to check for pockets of soft or loose material hidden beneath a thin crust of possibly better soil.
- Proof-rolling procedures should be observed routinely by a Professional Engineer or his designated representative.
- Any undesirable material (organic material, wet, soft, or loose soil) exposed during the proof-roll should be removed and replaced with well-compacted material as outlined in Section 7.3.
- Prior to placement of any fill, the exposed subgrade should then be scarified to a minimum depth of 6 inches and re-compacted as outlined in Section 7.3.

If fill is to be placed on existing slopes (natural or constructed) steeper than six horizontal to one vertical (6H:1V), the fill materials should be benched into the existing slopes in such a manner as to provide a minimum bench width of 5 ft. This should provide a good contact between the existing





soils and fill materials, reduce potential sliding planes, and allow relatively horizontal lift placements.

Slope stability analysis of embankments (natural or constructed) and global stability analysis for retaining walls was not within the scope of this study.

The contractor is responsible for designing any excavation slopes, temporary sheeting or shoring. Design of these structures should include any imposed surface surcharges. Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations. The contractor should also be aware that slope height, slope inclination or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state and/or federal safety regulations, such as OSHA Health and Safety Standard for Excavations, 29 CFR Part 1926, or successor regulations. Stockpiles should be placed well away from the edge of the excavation and their heights should be controlled so they do not surcharge the sides of the excavation. Surface drainage should be carefully controlled to prevent flow of water over the slopes and/or into the excavations. Construction slopes should be closely observed for signs of mass movement, including tension cracks near the crest or bulging at the toe. If potential stability problems are observed, a geotechnical engineer should be contacted immediately. Shoring, bracing or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Texas.

Due to the nature of the clayey soils found near the surface at the test borings, traffic of heavy equipment (including heavy compaction equipment) may create pumping and general deterioration of shallow soils. Therefore, some construction difficulties should be anticipated during periods when these soils are saturated.

## **7.2 Foundation Excavations**

*Care must be taken to shore the existing structures/features to prevent them from being undermined during deep excavations next to existing structures, flatwork and pavement.*

All foundation excavations should be properly monitored to verify loose, soft, or otherwise undesirable materials are removed and foundations will bear on satisfactory material. Soil exposed in the base of all foundation excavations should be protected against detrimental change in condition, such as surface sloughing, side disturbance, rain, or excessive drying.

Surface runoff should be drained away from excavations and not allowed to pond in the bottom of the excavation. Concrete for foundations should be placed as soon as practical after the excavation is made. That is, the exposed foundation soils should not be allowed to become excessively dry or wet before placement of concrete. Drilled piers should be excavated and concrete placed the same day.

Prolonged exposure of the bearing surface to air or water will result in changes in strength and compressibility of the bearing stratum. Therefore, if delays occur, straight shaft drilled piers should be slightly widened and deepened to provide a fresh penetration surface, or a new (deeper) full penetration should be provided.





All pier shafts should have a diameter of at least 2.0 ft or  $1/30^{\text{th}}$  the shaft length, whichever is greater, for pier stability considerations, to facilitate clean-out of the base and for proper monitoring. Concrete placed in pier holes should be directed through a tremie, hopper, or equivalent. Placement of concrete should be vertical through the center of the shaft without hitting the sides of the pier or reinforcement to reduce the possibility of segregation of aggregates. Concrete placed in piers should have a minimum slump of 5 inches (but not greater than 7 inches) to avoid potential honey-combing.

Observations during pier drilling should include, but not necessarily be limited to, the following items:

- Verification of proper bearing strata and consistency of subsurface stratification with regard to boring logs,
- Confirmation the minimum required penetration into the bearing strata is achieved,
- Complete removal of cuttings from bottom of pier holes,
- Proper handling of any observed water seepage and sloughing of subsurface materials,
- No more than 2 inches of standing water should be permitted in the bottom of pier holes prior to placing concrete, and
- Verification of pier diameter and steel reinforcement.

Groundwater was encountered at depths of about 35 to 37 ft below existing grade while drilling Borings 1, 2, 3, and 4. Groundwater was measured in the open bore holes at depths of about 35 to 40 ft in Borings 1, 2, 3, and 4, upon drilling completion. Groundwater was not encountered in Boring 5. From our experience, shallower groundwater seepage could be encountered during pier installation, and the risk of encountering seepage is increased during or after periods of precipitation. Temporary casing should be anticipated to control groundwater seepage that could occur in the clayey matrix or near the interface of the overburden soil and rock (marl), or from fractures in the soil and rock. Casing should be seated in the overburden soil or shale below the depth of seepage, and all water and loosened material should be removed from the cased excavation before starting the design penetration. As casing is extracted, care should be taken to maintain a positive head of plastic concrete and minimize the potential for intrusion of water seepage. It is recommended a separate bid item be provided for casing on the contractors' bid schedule.

Groundwater can also occur within fractures in the bearing stratum for drilled, straight-shaft piers and this may require extending the casing and deepening the piers. From our experience with similar soil and rock conditions, sometimes groundwater cannot be controlled by the use of casing, and underwater placement of pier concrete may be required. Special mix designs are usually required for tremied or pumped concrete. Proper concreting procedures should include placement of concrete from the bottom to the top of the pier using a sealed tremie or pumped concrete. The tremie should be maintained at least 5 feet into the wet concrete during placement. It is recommended a separate bid item be provided for casing and underwater concrete placement on



the contractor's bid schedule. Pier drilling contractors experienced in similar soil and groundwater conditions should be utilized for this project.

ALPHA should be contacted for further evaluations and recommendations if caving soils and/or groundwater seepage is encountered during straight shaft pier installation.

### **7.3 Fill Compaction**

Clayey soils with a plasticity index equal to or greater than 25 should be compacted to a dry density between 93 and 98 percent of standard Proctor maximum dry density (ASTM D 698). The compacted moisture content of the clays during placement should be within the range of +2 to +6 percentage points above the material's optimum moisture.

Clayey soils used for general fill with a PI less than 25 should be compacted to a dry density of at least 95 percent of standard Proctor maximum dry density (ASTM D 698). The compacted moisture content of the clays during placement should be within the range of -1 to +3 percentage points of the material's optimum moisture.

Clay fill should be processed and the largest particle or clod should be less than 6 inches prior to compaction.

In cases where fills are more than 10 ft deep, the fill/backfill below 10 ft should be compacted to at least 100 percent of standard Proctor maximum dry density (ASTM D 698) and within -2 to +2 percentage points of the material's optimum moisture content. The portion of the fill/backfill shallower than 10 ft should be compacted as previously outlined. Even if fill is properly compacted as discussed, fills in excess of about 10 ft are still subject to settlements over time of up to about 1 to 2 percent of the total fill thickness. This should be considered when designing areas with deep fill and/or wall backfill.

Compaction should be accomplished by placing fill in about 8-inch thick loose lifts and compacting each lift to at least the specified minimum dry density. Field density and moisture content tests should be performed on each lift.

In general site grading areas where final fill slopes will be four horizontal to one vertical (4:1) or steeper and greater than 5 ft in height, field density and moisture content tests should be performed on each lift.

### **7.4 Utilities**

In cases where utility lines are more than 10 ft deep, the fill/backfill below 10 ft should be compacted to at least 100 percent of standard Proctor maximum dry density (ASTM D 698) and within -2 to +2 percentage points of the material's optimum moisture content. The portion of the fill/backfill shallower than 10 ft should be compacted as previously outlined. Density tests should be performed on each lift (maximum 12-inch thickness) and should be performed as the trench is being backfilled.

*Even if fill is properly compacted, fills in excess of about 10 ft are still subject to settlements over time of up to about 1 to 2 percent of the total fill thickness. This should be considered when designing pavements and other structures over utility lines and other areas with deep fill. If this*



*potential for settlement is not acceptable, it may be necessary to backfill areas below 10 ft using flexible base material or low strength flowable fill. We should be contacted for further evaluation and recommendations.*

If utility trenches or other excavations extend to or beyond a depth of 5 ft below construction grade, the contractor or others shall be required to develop an excavation safety plan to protect personnel entering the excavation or excavation vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, is beyond the scope of this study. Any such designs and safety plans shall be developed in accordance with current OSHA guidelines and other applicable industry standards.

## **7.5 Groundwater**

Groundwater was encountered at depths of about 35 to 37 ft below existing grade while drilling Borings 1, 2, 3, and 4. Groundwater was measured in the open bore holes at depths of about 35 to 40 ft in Borings 1, 2, 3, and 4, upon drilling completion. Groundwater was not encountered in Boring 5. From our experience with similar soils, shallow groundwater seepage could be encountered in excavations for foundations, utility conduits, and other general excavations. The risk of encountering seepage increases with depth of excavation and during or after periods of precipitation. Standard sump pits and pumping may be adequate to control seepage on a local basis.

In any areas where cuts are made to establish final grades, attention should be given to possible seasonal water seepage that could occur through natural cracks and fissures in the newly exposed stratigraphy. Also, seasonal groundwater seepage could occur where shale is at or near the final site grade and where it is exposed in slopes and cuts. In these cases, subsurface drains may be required to intercept seasonal groundwater seepage. The need for these or other de-watering devices at the site should be carefully addressed during construction. Our office could be contacted to visually observe the final grades to evaluate the need for such drains.

## **8.0 LIMITATIONS**

Professional services provided in this geotechnical exploration were performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. The scope of services provided herein does not include an environmental assessment of the site or investigation for the presence or absence of hazardous materials in the soil, surface water or groundwater. ALPHA, upon written request, can be retained to provide these services.

ALPHA is not responsible for conclusions, opinions or recommendations made by others based on this data. Information contained in this report is intended for the exclusive use of the Client (and their designated design representatives), and is related solely to design of the specific structures outlined in Section 2.0. No party other than the Client (and their designated design representatives) shall use or rely upon this report in any manner whatsoever unless such party shall have obtained ALPHA's written acceptance of such intended use. Any such third party using this report after obtaining ALPHA's written acceptance shall be bound by the limitations and limitations of liability contained herein, including ALPHA's liability being limited to the fee paid to it for this report. Recommendations presented in this report should not be used for design of



any other structures except those specifically described in this report. In all areas of this report in which ALPHA may provide additional services if requested to do so in writing, it is presumed that such requests have not been made if not evidenced by a written document accepted by ALPHA. Further, subsurface conditions can change with passage of time. Recommendations contained herein are not considered applicable for an extended period of time after the completion date of this report. It is recommended our office be contacted for a review of the contents of this report for construction commencing more than one (1) year after completion of this report. Non-compliance with any of these requirements by the Client or anyone else shall release ALPHA from any liability resulting from the use of, or reliance upon, this report.

Recommendations provided in this report are based on our understanding of information provided by the Client about characteristics of the project. If the Client notes any deviation from the facts about project characteristics, our office should be contacted immediately since this may materially alter the recommendations. Further, ALPHA is not responsible for damages resulting from workmanship of designers or contractors. It is recommended the Owner retain qualified personnel, such as a Geotechnical Engineering firm, to verify construction is performed in accordance with plans and specifications.



# APPENDIX



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## **A-1 METHODS OF FIELD EXPLORATION**

Using standard rotary drilling equipment, five (5) widely spaced test borings were performed for this geotechnical exploration at the approximate locations shown on the Boring Location Plan – Figure 1. The test borings were located in the field using a handheld GPS device or by pacing or taping and estimating right angles from landmarks which could be identified in the field and as shown on the site plan provided during this study. The locations of the test borings shown on the Boring Location Plan – Figure 1, are considered accurate only to the degree implied by the methods used to define them.

Relatively undisturbed samples of the cohesive subsurface materials were obtained by hydraulically pressing 3-inch O.D. thin-wall sampling tubes into the underlying soils at selected depths (ASTM D 1587). These samples were removed from the sampling tubes in the field and examined visually. One representative portion of each sample was sealed in a plastic bag for use in future visual examinations and possible testing in the laboratory.

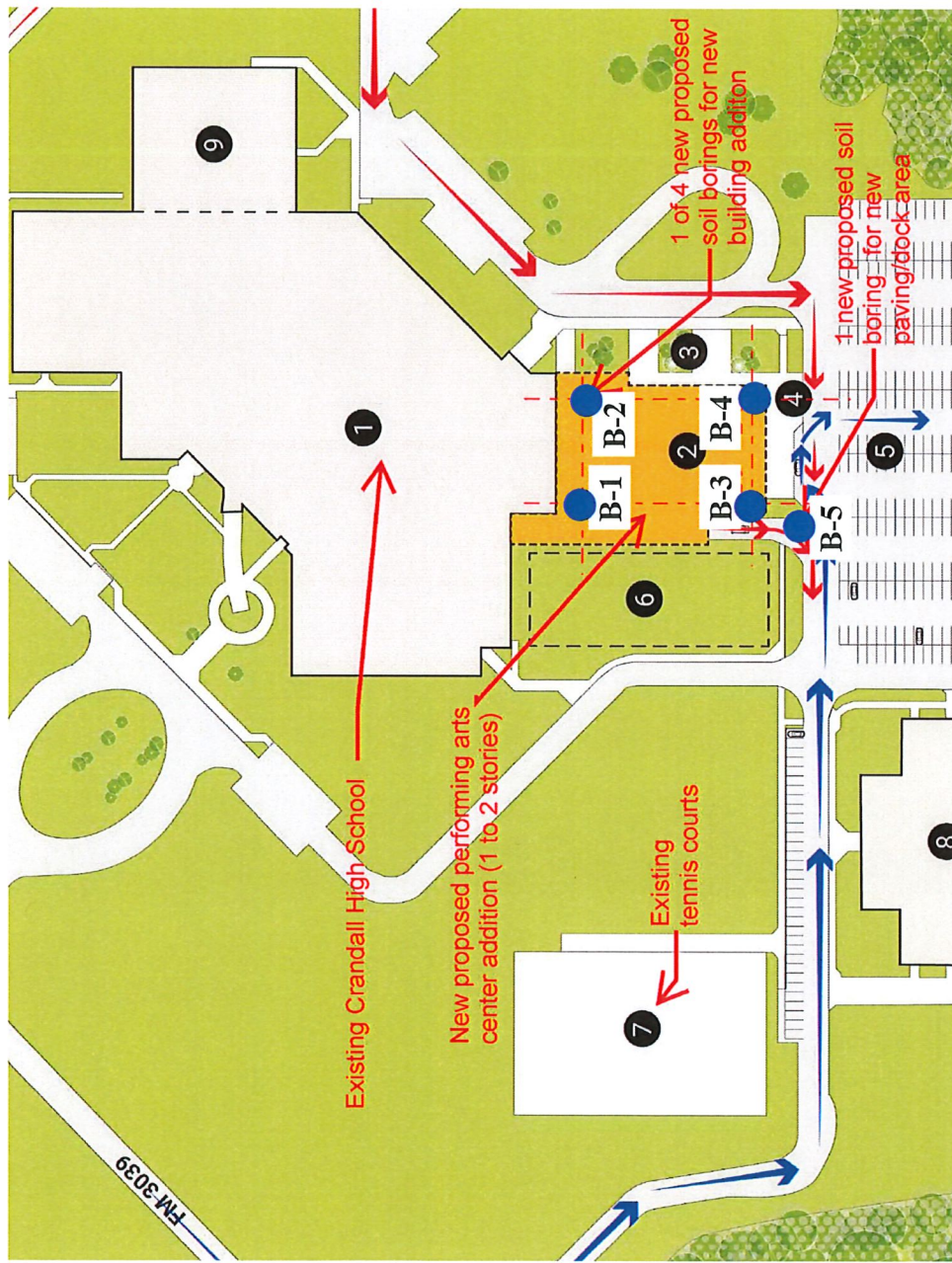
Representative samples of the subsurface materials were also obtained employing split-spoon sampling procedures in general accordance with ASTM Standard D 1586. Disturbed samples were obtained at selected depths in the borings by driving a standard 2-inch O.D. split-spoon sampler 18 inches into the subsurface material using either a 170-pound hammer falling 24 inches or a 140-pound hammer falling 30 inches. The number of blows required to drive the split-spoon sampler the final 12 inches of penetration (N-value) is recorded in the appropriate column on the Log of Boring sheets.

The Texas Cone Penetration (TCP) test was used to assess the apparent in-place strength characteristics of the rock type materials. The TCP test consists of a 3-inch diameter steel cone driven by a 170-pound hammer dropped 24 inches (340 ft-pounds of energy) and is the basis for TxDOT strength correlations. Depending on the resistance (strength) of the materials, either the number of blows of the hammer required to provide 12 inches of penetration, or the inches of penetration of the cone due to 100 blows of the hammer are recorded on the field logs and are shown on the Log of Boring sheets as “TX Cone” (reference: TxDOT Test Method TEX 132-E).

Boring logs are included in the Appendix. The boring logs show visual descriptions of subsurface strata encountered using the Unified Soil Classification System. Sampling information, pertinent field data and field observations are also included. Samples not consumed by testing will be retained in our laboratory for at least 14 days and then discarded unless the Client requests otherwise.

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● Approximate Boring Locations

Geotechnical Exploration  
 Performing Arts Center  
 Crandall High School  
 13385 F.M. 3039  
 Crandall, Texas  
 ALPHA Report No. G240443



Boring Location Plan  
 Figure 1



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## **B-1 METHODS OF LABORATORY TESTING**

Representative samples were examined and classified by a qualified member of the Geotechnical Division and the boring logs were edited as necessary. To aid in classifying the subsurface materials and to determine the general engineering characteristics, natural moisture content tests (ASTM D 2216), Atterberg-limit tests (ASTM D 4318), and percent of soils finer than No. 200 sieve (ASTM D1140) were performed on selected samples. In addition, unconfined compression tests (ASTM D 2166) and pocket-penetrometer tests were conducted on selected soil samples to evaluate the soil shear strength. Results of all laboratory tests described are provided on the accompanying Log of Boring sheets in the Appendix.

In addition to the Atterberg-limit tests, the expansive properties of the clay soils were further analyzed by an absorption swell test (ASTM D 4546). The swell test is performed by placing a selected sample in a consolidation machine and applying either the approximate current or expected overburden pressure and then allowing the sample to absorb water. When the sample exhibits very little tendency for further expansion, the height increase is recorded and the percent swell and total moisture gain calculated. Results of the absorption swell tests are provided on the Log of Boring sheets included in this Appendix.

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2209 Wisconsin St.  
 Dallas, Texas 75229  
 Phone: 972-620-8911  
 Fax: 972-620-1302  
 www.alphatesting.com

**BORING NO.:** 5

Sheet 1 of 1

**PROJECT NO.:** G240443

**Client:** Crandall ISD

**Location:** Crandall, TX

**Project:** Performing Arts Center - Crandall High School

**Surface Elevation:** \_\_\_\_\_

**Start Date:** 3/13/2024 **End Date:** 3/13/2024

**West:** \_\_\_\_\_

**Drilling Method:** CONTINUOUS FLIGHT AUGER



















**North:** \_\_\_\_\_

**Hammer Drop (lbs / in):** 170 / 24






Depth, feet	Graphic Log	GROUND WATER OBSERVATIONS			Sample Type	Recovery % RQD	TX Cone or Std. Pen. (blows/ft, in)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	UU Shear Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Swell, %
		▽ On Rods (ft):	NONE	▼ After Drilling (ft):													
		MATERIAL DESCRIPTION															
		5" CONCRETE and 2" Base	0.6														
5		Brown CLAY	5.0				1.5 2.0 2.0	0.7			82	39 38 38	80	28	52		
		TEST BORING TERMINATED AT 5 FT															
10																	
15																	
20																	
25																	
30																	
35																	
40																	
45																	
50																	
55																	
60																	
65																	
70																	
75																	

## KEY TO SOIL SYMBOLS AND CLASSIFICATIONS

### SOIL & ROCK SYMBOLS

	(CH), High Plasticity CLAY
	(CL), Low Plasticity CLAY
	(SC), CLAYEY SAND
	(SP), Poorly Graded SAND
	(SW), Well Graded SAND
	(SM), SILTY SAND
	(ML), SILT
	(MH), Elastic SILT
	LIMESTONE
	SHALE / MARL
	SANDSTONE
	(GP), Poorly Graded GRAVEL
	(GW), Well Graded GRAVEL
	(GC), CLAYEY GRAVEL
	(GM), SILTY GRAVEL
	(OL), ORGANIC SILT
	(OH), ORGANIC CLAY
	FILL

### SAMPLING SYMBOLS

	SHELBY TUBE (3" OD except where noted otherwise)
	SPLIT SPOON (2" OD except where noted otherwise)
	AUGER SAMPLE
	TEXAS CONE PENETRATION
	ROCK CORE (2" ID except where noted otherwise)

### RELATIVE DENSITY OF COHESIONLESS SOILS (blows/ft)

VERY LOOSE	0 TO 4
LOOSE	5 TO 10
MEDIUM	11 TO 30
DENSE	31 TO 50
VERY DENSE	OVER 50

### SHEAR STRENGTH OF COHESIVE SOILS (tsf)

VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.50
FIRM	0.50 TO 1.00
STIFF	1.00 TO 2.00
VERY STIFF	2.00 TO 4.00
HARD	OVER 4.00

### RELATIVE DEGREE OF PLASTICITY (PI)

LOW	4 TO 15
MEDIUM	16 TO 25
HIGH	26 TO 35
VERY HIGH	OVER 35

### RELATIVE PROPORTIONS (%)

TRACE	1 TO 10
LITTLE	11 TO 20
SOME	21 TO 35
AND	36 TO 50

### PARTICLE SIZE IDENTIFICATION (DIAMETER)

BOULDERS	8.0" OR LARGER
COBBLES	3.0" TO 8.0"
COARSE GRAVEL	0.75" TO 3.0"
FINE GRAVEL	5.0 mm TO 3.0"
COURSE SAND	2.0 mm TO 5.0 mm
MEDIUM SAND	0.4 mm TO 5.0 mm
FINE SAND	0.07 mm TO 0.4 mm
SILT	0.002 mm TO 0.07 mm
CLAY	LESS THAN 0.002 mm

## SECTION 01 10 00

### SUMMARY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Work performed by Owner.
  - 4. Owner-furnished/Contractor-installed (OFICI) products.
  - 5. Owner-furnished/Owner-installed (OFOI) products.
  - 6. Contractor's use of site and premises.
  - 7. Coordination with occupants.
  - 8. Work restrictions.
  - 9. Specification and Drawing conventions.

##### 1.2 PROJECT INFORMATION

- A. Project Identification: Performing Arts Center Additions to Crandall High School; Project No.39-23712-00.
  - 1. Project Location: Crandall, Texas.
- B. Owner: Crandall Independent School District.
- C. Architect: DLR Group; 2500 Pacific Avenue, Suite 1600, Dallas, Texas 75226.
- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
  - 1. Refer to Title Page.
- E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
  - 1. See Section 01 31 00 "Project Management and Coordination." for requirements for using web-based Project software.

##### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
  - 1. Renovation of existing band and percussion hall, and an approximately 32,000 sq. ft. building addition with stage, audience chamber, practice rooms, lobby, offices, back of house spaces, and other Work indicated in the Contract Documents.
- B. Type of Contract:
  - 1. Project will be constructed under a single prime contract.

##### 1.4 WORK PERFORMED BY OWNER

- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

##### 1.5 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFICI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
  - 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
  - 2. Provide for delivery of Owner-furnished products to Project site.
  - 3. Upon delivery, inspect, with Contractor present, delivered items.
    - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
  - 4. Obtain manufacturer's inspections, service, and warranties.
  - 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
  - 1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.

2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
  3. Receive, unload, handle, store, protect, and install Owner-furnished products.
  4. Make building services connections for Owner-furnished products.
  5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
  6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFICI) Products:
1. As scheduled.
- 1.6 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS
- A. The Owner will furnish and install products indicated.
- B. Owner-Furnished/Owner-Installed (OFOI) Products:
1. As scheduled.
- 1.7 CONTRACTOR'S USE OF SITE AND PREMISES
- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.
- 1.8 COORDINATION WITH OCCUPANTS
- A. Full Owner Occupancy: Owner will occupy Project site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- 1.9 WORK RESTRICTIONS
- A. Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
1. Weekend Hours: Coordinate with Owner.
  2. Early Morning Hours: Coordinate with Owner.
  3. Work in Existing Building: Coordinate with Owner.
  4. Hours for Utility Shutdowns: Coordinate with Owner.
  5. Hours for Noisy Activities: Coordinate with Owner.



- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
  - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.
- F. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Project site and on Owner's property is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
  - 1. Maintain list of approved screened personnel with Owner's representative.

#### 1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 22 00

### UNIT PRICES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

##### 1.2 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

##### 1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

#### PART 2 - PRODUCTS (NOT USED)

#### PART 3 - EXECUTION

##### 3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1 – Moisture Vapor Emission Control System: Refer to Section 09 05 61.13 "Moisture Vapor Emission Control System."
  - 1. Provide cost per square foot for complete system, including shot-blasting concrete substrate, application of penetrant, post-application moisture and alkalinity testing, application of cementitious underlayment, and manufacturer's 15-year warranty.
- B. Unit Price No. 2 – Drilled Piers:
  - 1. For actual depth versus anticipated depth indicated on Drawings.
  - 2. Cost of providing and placing casings is not included Base Contract.
  - 3. Reconciliation: Per pier diameter category for net add or deduct, not per individual pier.
  - 4. Diameter Categories: Refer to Structural Drawings.
  - 5. For each diameter category pier required, provide:
    - a. Unit price per additional lineal foot of completed pier.
    - b. Unit price per deleted lineal foot of completed pier. Unit price shall be no less than 75 percent of unit price for additional lineal foot.
- C. Unit Price No. 3 – Addition of Casing: Base Bid price shall not include casing of drilled concrete piers. Provide Unit Price for addition of steel casing to a depth of 20 feet below grade in the event casing of piers is required by encountered subsurface conditions:
  - 1. Include cost of providing uncased drilled piers in Base Contract.
  - 2. Reconciliation: Per pier diameter category for net add per individual pier.
  - 3. Diameter Categories: Refer to Structural Drawings.

END OF SECTION

## SECTION 01 25 00

### SUBSTITUTION PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

##### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

##### 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation in PDF electronic format identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form provided in Project Manual.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.
    - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
    - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
    - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
    - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
    - k. Cost information, including a proposal of change, if any, in the Contract Sum.
    - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
    - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Any substitution request made that is not on required form, is not completely filled in, or does not provide required backup documentation will be rejected without review.
4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven business days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 business days of receipt of request, or seven business days of receipt of additional information or documentation, whichever is later.
  - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

#### 1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

#### 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
  1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
  1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.
    - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - g. Requested substitution is compatible with other portions of the Work.
    - h. Requested substitution has been coordinated with other portions of the Work.

- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SUBSTITUTION REQUEST FORM**

PROJECT: \_\_\_\_\_ **(After Contract Award)**  
TO: \_\_\_\_\_  
NO. \_\_\_\_\_ DATE: \_\_\_\_\_

Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Division 01 Section "Substitution Procedures:"

**1. SPECIFIED PRODUCT OR SYSTEM**

Substitution request for: \_\_\_\_\_

Specification Section No.: \_\_\_\_\_ Article/ Paragraph: \_\_\_\_\_

**2. REASON FOR SUBSTITUTION REQUEST**

SPECIFIED PRODUCT . . .

PROPOSED PRODUCT . . .

- |  |  |
|--|--|
| <input type="checkbox"/> Is no longer available.                                 | <input type="checkbox"/> Will reduce construction time                         |
| <input type="checkbox"/> Is unable to meet project schedule.                     | <input type="checkbox"/> Will result in cost savings of<br>\$ _____ to Project |
| <input type="checkbox"/> Is unsuitable for the designated application.           | <input type="checkbox"/> Is for supplier's convenience                         |
| <input type="checkbox"/> Cannot interface with adjacent materials.               | <input type="checkbox"/> Is for subcontractor's convenience                    |
| <input type="checkbox"/> Is not compatible with adjacent materials.              | <input type="checkbox"/> Other: _____  |
| <input type="checkbox"/> Cannot provide the specified warranty.                  |  |
| <input type="checkbox"/> Cannot be constructed as indicated                      |  |
| <input type="checkbox"/> Cannot be obtained due to one or more of the following: |  |
| <input type="checkbox"/> Strike  | <input type="checkbox"/> Bankruptcy of manufacturer or supplier                |
| <input type="checkbox"/> Lockout   | <input type="checkbox"/> Similar occurrence (explain below)                    |

**3. SUPPORTING DATA**

- Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request are attached.
- Sample is attached.  Sample will be sent if requested.

**4. QUALITY COMPARISON:** Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

	SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer:	_____	_____
Name / Brand:	_____	_____
Catalog No.:	_____	_____
Vendor:	_____	_____
Variations:	_____	_____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: \_\_\_\_\_  
Maintenance Service Available:  Yes  No  
Spare Parts Source: \_\_\_\_\_  
Warranty:  Yes  No \_\_\_\_\_ Years

**5. PREVIOUS INSTALLATIONS**

Identification of at least three similar projects on which proposed substitution was used:

PROJECT #1: \_\_\_\_\_  
Address: \_\_\_\_\_  
Architect: \_\_\_\_\_  
Owner: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

PROJECT #2: \_\_\_\_\_  
Address: \_\_\_\_\_  
Architect: \_\_\_\_\_  
Owner: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

PROJECT #3: \_\_\_\_\_  
Address: \_\_\_\_\_  
Architect: \_\_\_\_\_  
Owner: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Date Installed: \_\_\_\_\_

**6. EFFECT OF SUBSTITUTION**

Proposed substitution affects other work or trades:     No     Yes (if Yes, explain)

\_\_\_\_\_

Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:

No                       Yes (if Yes, attach data explaining revisions)

**7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS**

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

- A. They have personally investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated above;
- B. The proposed substitution is in compliance with applicable codes and ordinances;
- C. The proposed substitution will provide same warranty as specified for specified product;
- D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;
- E. They have included complete cost data and implications of the substitution (attached);
- F. They will pay any redesign fees incurred by the Architect or any of the Architect's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;
- G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.
- H. The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Contractor: \_\_\_\_\_  
(Name of Contractor)

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

Subcontractor: \_\_\_\_\_  
(Name of Subcontractor)

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

**Note: Unresponsive or incomplete requests will be rejected and returned without review.**

**8. ARCHITECT'S REVIEW AND ACTION**

- Substitution is accepted.
- Substitution is accepted, with the following comments: \_\_\_\_\_  
\_\_\_\_\_

- Resubmit Substitution Request:
  - Provide more information in the following areas: \_\_\_\_\_  
\_\_\_\_\_

- Provide proposal indicating amount of savings / credit to Owner
- Bidding Contractor shall sign Bidder's Statement of Conformance
- Bidding Subcontractor shall sign Bidder's Statement of Conformance

- Substitution is not accepted:
  - Substitution Request received too late.
  - Substitution Request received directly from subcontractor or supplier.
  - Substitution Request not submitted in accordance with requirements.
  - Substitution Request Form is not properly executed.
  - Substitution Request does not indicate what item is being proposed.
  - Insufficient information submitted to facilitate proper evaluation.
  - Proposed product does not appear to comply with specified requirements.
  - Proposed product will require substantial revisions to Contract Documents.

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

Architect has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

**9. OWNER'S REVIEW AND ACTION**

- Substitution is accepted; Architect to prepare Change Order.
- Substitution is not accepted.
- Owner will pay Architect directly for redesign fees.
- Include Architect's Additional Service fee for implementing the substitution in the Change Order.

By: \_\_\_\_\_ Date: \_\_\_\_\_  
(Owner/Owner's Representative)

**END OF FORM**



## SECTION 01 26 00

### CONTRACT MODIFICATION PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

##### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

##### 1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
  - 1. Within 7 days after submittal of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
  - 2. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
  - 3. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  - 4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  - 5. Include costs of labor and supervision directly attributable to the change.
  - 6. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  - 7. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
  - 8. Proposal Request Form: Use form acceptable to Architect.
- C. Do not proceed with changes until receipt of written approval by Architect and Owner.

##### 1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 29 00

### PAYMENT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

##### 1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

##### 1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Owner's name.
    - c. Owner's Project number.
    - d. Name of Architect.
    - e. Architect's Project number.
    - f. Contractor's name and address.
    - g. Date of submittal.
  - 2. Arrange schedule of values consistent with format of AIA Document G703.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    - a. Differentiate between items stored on-site and items stored off-site.
  - 5. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
  - 6. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
  - 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
  - 8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

##### 1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
  - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
  - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  - 3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of values.
  - 3. Contractor's construction schedule (preliminary if not final).
  - 4. Products list (preliminary if not final).
  - 5. Schedule of unit prices.
  - 6. Submittal schedule (preliminary if not final).
  - 7. List of Contractor's staff assignments.
  - 8. List of Contractor's principal consultants.
  - 9. Copies of building permits.
  - 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  - 11. Initial progress report.
  - 12. Report of preconstruction conference.

13. Certificates of insurance and insurance policies.
  14. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 77 00 "Closeout Procedures."
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Updated final statement, accounting for final changes to the Contract Sum.
  5. AIA Document G706.
  6. AIA Document G706A.
  7. Evidence that claims have been settled.
  8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  9. Final liquidated damages settlement statement.
  10. Proof that taxes, fees, and similar obligations are paid.
  11. Waivers and releases.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 31 00

### PROJECT MANAGEMENT AND COORDINATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
  - 1. Coordination drawings.
  - 2. RFIs.
  - 3. Digital project management procedures.
  - 4. Web-based Project management software package.
  - 5. Project meetings.

##### 1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

##### 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.

7. Project closeout activities.
8. Startup and adjustment of systems.

#### 1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - e. Indicate required installation sequences.
    - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Process: Prepare coordination drawings in the following manner:
  1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
  2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
  3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
  4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
  5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
  6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
  7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
  1. File Preparation Format:
    - a. Same digital data software program, version, and operating system as original Drawings.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
  3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
  4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Owner name.
  3. Owner's Project number.
  4. Name of Architect.
  5. Architect's Project number.
  6. Date.
  7. Name of Contractor.
  8. RFI number, numbered sequentially.
  9. RFI subject.
  10. Specification Section number and title and related paragraphs, as appropriate.
  11. Drawing number and detail references, as appropriate.
  12. Field dimensions and conditions, as appropriate.
  13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  14. Contractor's signature.
  15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number, including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.



7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

#### 1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM] model will be provided by Architect for Contractor's use during construction, .
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
  2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
    - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
  4. The following digital data files will be furnished for each appropriate discipline:
    - a. Floor plans.
    - b. Reflected ceiling plans.
- B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software includes, at a minimum, the following features:
    - a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    - c. Document workflow planning, allowing customization of workflow between project entities.
    - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    - e. Track status of each Project communication in real time, and log time and date when responses are provided.
    - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    - g. Processing and tracking of payment applications.
    - h. Processing and tracking of contract modifications.
    - i. Creating and distributing meeting minutes.
    - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    - k. Management of construction progress photographs.
    - l. Mobile device compatibility, including smartphones and tablets.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
  3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

#### 1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Critical work sequencing and long lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Use of web-based Project software.
    - g. Procedures for processing field decisions and Change Orders.
    - h. Procedures for RFIs.
    - i. Procedures for testing and inspecting.
    - j. Procedures for processing Applications for Payment.
    - k. Distribution of the Contract Documents.
    - l. Submittal procedures.
    - m. Preparation of Record Documents.
    - n. Use of the premises.
    - o. Work restrictions.
    - p. Working hours.
    - q. Owner's occupancy requirements.
    - r. Responsibility for temporary facilities and controls.
    - s. Procedures for moisture and mold control.
    - t. Procedures for disruptions and shutdowns.
    - u. Construction waste management and recycling.
    - v. Parking availability.
    - w. Office, work, and storage areas.
    - x. Equipment deliveries and priorities.
    - y. First aid.
    - z. Security.
    - aa. Progress cleaning.
  3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Weather limitations.

- m. Manufacturer's written instructions.
  - n. Warranty requirements.
  - o. Compatibility of materials.
  - p. Acceptability of substrates.
  - q. Temporary facilities and controls.
  - r. Space and access limitations.
  - s. Regulations of authorities having jurisdiction.
  - t. Testing and inspecting requirements.
  - u. Installation procedures.
  - v. Coordination with other work.
  - w. Required performance results.
  - x. Protection of adjacent work.
  - y. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Procedures for completing and archiving web-based Project software site data files.
    - d. Submittal of written warranties.
    - e. Requirements for preparing operations and maintenance data.
    - f. Requirements for delivery of material samples, attic stock, and spare parts.
    - g. Requirements for demonstration and training.
    - h. Preparation of Contractor's punch list.
    - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - j. Submittal procedures.
    - k. Owner's partial occupancy requirements.
    - l. Installation of Owner's furniture, fixtures, and equipment.
    - m. Responsibility for removing temporary facilities and controls.
  - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Resolution of BIM component conflicts.
    - 4) Status of submittals.
    - 5) Deliveries.
    - 6) Off-site fabrication.
    - 7) Access.
    - 8) Site use.
    - 9) Temporary facilities and controls.
    - 10) Progress cleaning.
    - 11) Quality and work standards.
    - 12) Status of correction of deficient items.
    - 13) Field observations.
    - 14) Status of RFIs.
    - 15) Status of Proposal Requests.
    - 16) Pending changes.
    - 17) Status of Change Orders.
    - 18) Pending claims and disputes.
    - 19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
  - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 32 00

### CONSTRUCTION PROGRESS DOCUMENTATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Daily construction reports.
  - 3. Material location reports.
  - 4. Site condition reports.
  - 5. Unusual event reports.

##### 1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file.
  - 2. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
    - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
    - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
    - 3. Total Float Report: List of activities sorted in ascending order of total float.
    - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
  - E. Construction Schedule Updating Reports: Submit with Applications for Payment.
  - F. Daily Construction Reports: Submit at weekly intervals.
  - G. Weekly Reports: Submit brief description of work achieved that week with four photos. Note weather Conditions.
  - H. Material Location Reports: Submit location report of materials stored off-site at monthly intervals.
  - I. Site Condition Reports: Submit at time of discovery of differing conditions.
  - J. Unusual Event Reports: Submit at time of unusual event.
  - K. Qualification Data: For scheduling consultant.
- 1.4 QUALITY ASSURANCE
- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
    - 1. Review software limitations and content and format for reports.
    - 2. Verify availability of qualified personnel needed to develop and update schedule.
    - 3. Discuss constraints, including work stages.
    - 4. Review delivery dates for Owner-furnished products.
    - 5. Review schedule for work of Owner's separate contracts.
    - 6. Review submittal requirements and procedures.
    - 7. Review time required for review of submittals and resubmittals.
    - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
    - 9. Review time required for Project closeout and Owner startup procedures.
    - 10. Review and finalize list of construction activities to be included in schedule.
    - 11. Review procedures for updating schedule.
- 1.5 COORDINATION
- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
    - 1. Secure time commitments for performing critical elements of the Work from entities involved.
    - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.
- 1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE
- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  - B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
    - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
  - C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
    - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
    - a. Securing of approvals and permits required for performance of the Work.
    - b. Temporary facilities.
    - c. Construction of mock-ups, prototypes and samples.
    - d. Owner interfaces and furnishing of items.
    - e. Interfaces with Separate Contracts.
    - f. Regulatory agency approvals.
    - g. Punch list.
  3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  6. Commissioning Time: Include no fewer than 15 days for commissioning.
  7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Use-of-premises restrictions.
    - e. Seasonal variations.
    - f. Environmental control.
  2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Mockups.
    - e. Fabrication.
    - f. Sample testing.
    - g. Deliveries.
    - h. Installation.
    - i. Tests and inspections.
    - j. Adjusting.
    - k. Curing.
    - l. Startup and placement into final use and operation.
    - m. Commissioning.
  3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Temporary enclosure and space conditioning.
    - c. Permanent space enclosure.
    - d. Completion of mechanical installation.
    - e. Completion of electrical installation.
    - f. Substantial Completion.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.

- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
  - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in Project meeting rooms and temporary field offices.
  - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

#### 1.7 STARTUP CONSTRUCTION SCHEDULE

- A. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

#### 1.8 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
  - 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for commencement of the Work.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
  - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
  - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.



- d. Delivery.
- e. Fabrication.
- f. Utility interruptions.
- g. Installation.
- h. Work by Owner that may affect or be affected by Contractor's activities.
- i. Testing and inspection.
- j. Commissioning.
- k. Punch list and Final Completion.
- l. Activities occurring following Final Completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
  - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
  - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
  - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
  1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.
  6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
  10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
  1. Identification of activities that have changed.
  2. Changes in early and late start dates.
  3. Changes in early and late finish dates.
  4. Changes in activity durations in workdays.
  5. Changes in the critical path.
  6. Changes in total float or slack time.
  7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
  1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
  2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
  3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
  4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

- b. Submit value summary printouts one week before each regularly scheduled progress meeting.

#### 1.9 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions, including presence of rain or snow.
  7. Testing and inspection.
  8. Accidents.
  9. Meetings and significant decisions.
  10. Unusual events.
  11. Stoppages, delays, shortages, and losses.
  12. Meter readings and similar recordings.
  13. Emergency procedures.
  14. Orders and requests of authorities having jurisdiction.
  15. Change Orders received and implemented.
  16. Construction Change Directives received and implemented.
  17. Services connected and disconnected.
  18. Equipment or system tests and startups.
  19. Partial completions and occupancies.
  20. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
  1. Material stored prior to previous report and remaining in storage.
  2. Material stored prior to previous report and since removed from storage and installed.
  3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
  1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 32 33

### PHOTOGRAPHIC DOCUMENTATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Concealed Work photographs.
  - 3. Periodic construction photographs.
  - 4. Final Completion construction photographs.
  - 5. Preconstruction video recordings.
  - 6. Periodic construction video recordings.

##### 1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.
- C. Video Recordings: Submit video recordings within seven days of recording.
  - 1. Submit video recordings by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
  - 2. Identification: With each submittal, provide the following information in file metadata tag:
    - a. Name of Project.
    - b. Name and address of photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date video recording was recorded.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

##### 1.3 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time and GPS location data from camera.
- E. File Names: Name media files with date and sequential numbering suffix.

#### 1.4 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
  - 1. Underground utilities.
  - 2. Underslab services.
  - 3. Piping.
  - 4. Electrical conduit.
  - 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take 20 photographs monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
  - 1. Frequency: Take photographs monthly, on the same date each month.
  - 2. Vantage Points: Following suggestions by Architect and Contractor, photographer shall select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time, to create a time-lapse sequence as follows:
    - a. Commencement of the Work, through completion of subgrade construction.
    - b. Above-grade structural framing.
    - c. Exterior building enclosure.
    - d. Interior Work, through date of Substantial Completion.
- F. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.
- G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
  - 1. Three days' notice will be given, where feasible.
  - 2. In emergency situations, take additional photographs within 24 hours of request.
  - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Immediate follow-up when on-site events result in construction damage or losses.
    - b. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    - c. Substantial Completion of a major phase or component of the Work.
    - d. Extra record photographs at time of final acceptance.

#### 1.5 CONSTRUCTION VIDEO RECORDINGS

- A. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
  - 1. Confirm date and time at beginning and end of recording.
  - 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

- B. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.
- C. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.
  - 1. Flag construction limits before recording construction video recordings.
  - 2. Show existing conditions adjacent to Project site before starting the Work.
  - 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
  - 4. Show protection efforts by Contractor.
- D. Periodic Construction Video Recordings: Record video recording monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be 30 minutes(s).

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Submittal schedule requirements.
  - 2. Administrative and procedural requirements for submittals.

##### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

##### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
  - 4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal Category: Action; informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's final release or approval.
    - g. Scheduled dates for purchasing.
    - h. Scheduled date of fabrication.
    - i. Scheduled dates for installation.
    - j. Activity or event number.

##### 1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Architect.
  - 4. Name of Contractor.
  - 5. Name of firm or entity that prepared submittal.
  - 6. Names of subcontractor, manufacturer, and supplier.

7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
  8. Category and type of submittal.
  9. Submittal purpose and description.
  10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  11. Drawing number and detail references, as appropriate.
  12. Indication of full or partial submittal.
  13. Location(s) where product is to be installed, as appropriate.
  14. Other necessary identification.
  15. Remarks.
  16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.
- 1.5 SUBMITTAL PROCEDURES
- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 business days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 business days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

#### 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  - 2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  - 3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  - 4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.



5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.

5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
  5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
  6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    - a. Name of evaluation organization.
    - b. Date of evaluation.
    - c. Time period when report is in effect.
    - d. Product and manufacturers' names.
    - e. Description of product.
    - f. Test procedures and results.
    - g. Limitations of use.
- 1.7 DELEGATED-DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
    1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
  - B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
    1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
  - C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.
    1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.
- 1.8 CONTRACTOR'S REVIEW
- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

- 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.

- 1. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

- 2. Action Submittals: Architect will review each submittal, mark to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp, and mark the stamp appropriately to indicate the action taken, as follows:

- a. Final Unrestricted Release: Where the submittal is marked "Approved," the Work covered by the submittal may proceed, provided it complies with the Contract Documents. Final acceptance will depend on that compliance.
    - b. Final-but-Restricted Release: Where the submittal is marked "Approved as Noted," the Work covered by the submittal may proceed, provided it complies both with Architect's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.
    - c. Resubmit: Where the submittal is marked "Not Approved, Revise and Resubmit," do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Architect's notations and corrections.
    - d. Rejected: Where the submittal is marked "Not Approved, Resubmit" or "Rejected," do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.
    - e. Incomplete - Resubmit: Where the submittal is marked "Submit Additional Information," do not proceed with the Work covered by the submittal. Prepare additional information requested, or required by the Contract Documents, that indicates compliance with requirements, and resubmit.
    - f. Other Action: If the submittal is primarily for information purposes, record purposes, special processing, or other Contractor activity, the submittal will be returned marked "Action Not Required."

- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

- E. Architect will return without review submittals received from sources other than Contractor.

- F. Submittals not required by the Contract Documents will be returned by Architect without action.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 35 16

### ALTERATION PROJECT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes special procedures for alteration work.

##### 1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Retain: To keep an element or detail secure and intact.
- J. Strip: To remove existing finish down to base material unless otherwise indicated.

##### 1.3 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
  - 1. Schedule construction operations in sequence required to obtain best Work results.
  - 2. Coordinate sequence of alteration work activities to accommodate the following:
    - a. Owner's continuing occupancy of portions of existing building.
    - b. Other known work in progress.
    - c. Tests and inspections.
  - 3. Detail sequence of alteration work, with start and end dates.
  - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
  - 5. Use of elevator and stairs.
  - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns and adjacent to restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

#### 1.4 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.
1. Attendees: In addition to representatives of Owner, Architect, and Contractor, Owner's insurer, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
  2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
    - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Fire-prevention plan.
    - c. Governing regulations.
    - d. Areas where existing construction is to remain and the required protection.
    - e. Hauling routes.
    - f. Sequence of alteration work operations.
    - g. Storage, protection, and accounting for salvaged and specially fabricated items.
    - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
    - i. Qualifications of personnel assigned to alteration work and assigned duties.
    - j. Requirements for extent and quality of work, tolerances, and required clearances.
    - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
  3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at weekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
  2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
    - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
    - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
      - 1) Interface requirements of alteration work with other Project Work.
      - 2) Status of submittals for alteration work.
      - 3) Access to alteration work locations.
      - 4) Effectiveness of fire-prevention plan.
      - 5) Quality and work standards of alteration work.
      - 6) Change Orders for alteration work.
  3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
  - 1. Submit alteration work subschedule within seven days of date established for commencement of alteration work.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit 30 days before work begins.
- D. Fire-Prevention Plan: Submit 30 days before work begins.

1.6 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.
  - 1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
  - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
  - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
  - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
  - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area on-site.
  - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
  - 1. Repair and clean items for reuse as indicated.
  - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
  - 1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
  - 2. Secure stored materials to protect from theft.
  - 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

#### 1.8 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs.
  - 1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

### **PART 2 - PRODUCTS - (NOT USED)**

### **PART 3 - EXECUTION**

#### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
  - 1. Use only proven protection methods, appropriate to each area and surface being protected.
  - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
  - 3. Erect temporary barriers to form and maintain fire-egress routes.
  - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
  - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
  - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
  - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
  - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
  - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
  - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
  - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
  - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
  - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
  - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
  - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection as indicated on Drawings.

### 3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
  - 1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
  - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
    - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
  - 1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
  - 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
  - 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  - 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
  - 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  - 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
    - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
    - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
    - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
    - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
    - e. Maintain fire-watch personnel at Project site until two hours after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
  - 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

### 3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.



- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 01 32 33 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
  - 1. Do not proceed with the work in question until directed by Architect.

**END OF SECTION**

## SECTION 01 40 00

### QUALITY REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

##### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
  - 1. Mockups are used for one or more of the following:
    - a. Verify selections made under Sample submittals.
    - b. Demonstrate aesthetic effects.
    - c. Demonstrate the qualities of products and workmanship.
    - d. Demonstrate successful installation of interfaces between components and systems.
    - e. Perform preconstruction testing to determine system performance.
  - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
  - 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### 1.3 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.5 ACTION SUBMITTALS

- A. Mockup Shop Drawings:
  - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
  - 2. Indicate manufacturer and model number of individual components.
  - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

#### 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of commencement of work, and not less than days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

#### 1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
  2. Project title and number.
  3. Name, address, telephone number, and email address of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement of whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement of whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

#### 1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
  - J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
    - 1. Provide test specimens representative of proposed products and construction.
    - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
    - 5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
    - 6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  - K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
    - 1. Build mockups of size indicated.
    - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
    - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
    - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
    - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
    - 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
      - a. Allow seven business days for initial review and each re-review of each mockup.
    - 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
    - 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
    - 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    - 10. Demolish and remove mockups when directed unless otherwise indicated.
  - L. Specialty Mockups: See Section 01 43 39 "Mockups" for additional construction requirements for integrated exterior mockups.
- 1.10 QUALITY CONTROL
- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
    - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
    - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
  - B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
    - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.

2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
  1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected Work.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
  1. Submit log at Project closeout as part of Project Record Documents.

#### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION**



## SECTION 01 42 00

### REFERENCES

#### PART 1 - GENERAL

##### 1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Day" as used in the Contract Documents means calendar day unless otherwise specifically defined.
- D. "Business Day" as used in the Contract Documents means Monday through Friday and specifically does not include Saturday, Sunday, or holidays.
- E. "Working Day" as used in the Contract Documents means Monday through Friday and specifically does not include Saturday, Sunday, or holidays.
- F. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- G. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- H. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- I. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- J. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- K. "Provide": Furnish and install, complete and ready for the intended use.
- L. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

##### 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
  - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

##### 1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

Performing Arts Center Addition to Crandall High School  
Crandall, Texas  
Issue for Bid and Permit

DLR Group  
39-23712-00  
25 July 2024

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 43 39

### MOCKUPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Integrated exterior mockups.

##### 1.2 DEFINITIONS

- A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Meet with Owner, Architect, and installers of major systems whose Work is included in integrated exterior mockups.
  - 2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
  - 3. Review locations and extent of mockups.
  - 4. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and maintain schedule for the Work.

##### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups.
  - 1. Include plans, elevations, sections, and mounting, attachment, and support details.
  - 2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
  - 3. Include site location drawing indicating orientation of mockup.
- B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

##### 1.5 INFORMATIONAL SUBMITTALS

##### 1.6 QUALITY ASSURANCE

- A. Build mockups to do the following:
  - 1. Verify selections made under Sample submittals.
  - 2. Demonstrate aesthetic effects.
  - 3. Demonstrate the qualities of products and workmanship.
  - 4. Demonstrate acceptable coordination between components and systems.
- B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.
  - 1. Build mockups of size indicated.
  - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 6. Demolish and remove mockups when directed unless otherwise indicated.
- C. Notifications:
  - 1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
  - 2. Allow seven days for initial review and each re-review of each mockup.

- D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.
  - 1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 COORDINATION

- A. Coordinate schedule for construction of mockups, so construction and review of mockups do not impact Project schedule.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design support structure for free-standing mockups.
- B. Structural Performance:
  - 1. Wind Loads: As indicated on Drawings.

2.2 INTEGRATED EXTERIOR MOCKUPS

- A. Construct integrated exterior mockups according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.
- C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.
- D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.
- E. The Work of integrated exterior mockups includes, but is not limited to, the following:
  - 1. Masonry veneer.
  - 2. Cold-formed metal framing and sheathing.
  - 3. Air and weather barriers.
  - 4. Thermal insulation.
  - 5. Through-wall flashing.
  - 6. Flashing and sheet metal trim.
  - 7. Joint sealants.
  - 8. Metal wall panels.
  - 9. Aluminum-framed entrances and storefront.
  - 10. Glazing.
- F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 01 32 33 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.
- G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work. Obtain Architect's approval for modifications.
- H. Retain approved mockups constructed in place. Incorporate fully into the Work.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

##### 1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Erosion and Sedimentation Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
  - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  - 3. Indicate methods to be used to avoid trapping water in finished work.
- G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste-handling procedures.
  - 5. Other dust-control measures.
- H. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
  - 1. Methods used to meet the goals and requirements of the Owner.
  - 2. Concrete cutting method(s) to be used.
  - 3. Location of construction devices on the site.

4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines, Texas Accessibility Standards (TAS), and ICC/ANSI A117.1.

#### 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

### **PART 2 - PRODUCTS**

#### 2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

#### 2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
  2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
  3. Drinking water and private toilet.
  4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
  5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  1. Store combustible materials apart from building.

#### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

### **PART 3 - EXECUTION**

#### **3.1 TEMPORARY FACILITIES, GENERAL**

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

#### **3.2 INSTALLATION, GENERAL**

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

#### **3.3 TEMPORARY UTILITY INSTALLATION**

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service overhead unless otherwise indicated.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one land-based telephone line(s) for each field office.
  - 1. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Contractor's emergency after-hours telephone number.
    - e. Architect's office.

- f. Engineers' offices.
  - g. Owner's office.
  - h. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- 1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions with wireless connectivity.
  - 2. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
- 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
  - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.
- 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
- 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Civil Engineer's documents.
  - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Civil Engineer's documents.
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
- 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary offsite parking areas for construction personnel.
- F. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
- 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
- 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  - 3. Maintain and touch up signs, so they are legible at all times.
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 73 00 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
- 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.



- K. Temporary Elevator Use: See Division 14 elevator Section for temporary use of new elevators.
- L. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
  - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 01 56 39 "Temporary Tree and Plant Protection."
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard and replace stored or installed material that begins to grow mold.
  - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

**END OF SECTION**

## SECTION 01 56 39

### TEMPORARY TREE AND PLANT PROTECTION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

##### 1.2 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- C. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
    - b. Arborist's responsibilities.
    - c. Quality-control program.
    - d. Coordination of Work and equipment movement with the locations of protection zones.
    - e. Trenching by hand or with air spade within protection zones.
    - f. Field quality control.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
  - 2. Detail fabrication and assembly of protection-zone fencing and signage.
  - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
  - 1. Species and size of tree.
  - 2. Location on site plan. Include unique identifier for each.
  - 3. Reason for pruning.
  - 4. Description of pruning to be performed.
  - 5. Description of maintenance following pruning.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- B. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

- C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
    - 1. Use sufficiently detailed photographs or video recordings.
    - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
  - D. Quality-control program.
- 1.6 QUALITY ASSURANCE
- A. Arborist Qualifications: Certified Arborist as certified by ISA.
  - B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
  - C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.
- 1.7 FIELD CONDITIONS
- A. The following practices are prohibited within protection zones:
    - 1. Storage of construction materials, debris, or excavated material.
    - 2. Moving or parking vehicles or equipment.
    - 3. Foot traffic.
    - 4. Erection of sheds or structures.
    - 5. Impoundment of water.
    - 6. Excavation or other digging unless otherwise indicated.
    - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
  - B. Do not direct vehicle or equipment exhaust toward protection zones.
  - C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

## **PART 2 - PRODUCTS**

- 2.1 MATERIALS
- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
    - 1. Type: Shredded hardwood.
    - 2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
    - 3. Color: Natural.
  - B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements: Previously used materials may be used when approved by Architect.
    - 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
      - a. Height: 48 inches (1200 mm).
    - 2. Gates: Single- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 24 inches (610 mm).
  - C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
    - 1. Size and Text: As shown on Drawings.
    - 2. Lettering: 3-inch- (75-mm-) high minimum, white characters on red background.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

#### **3.2 PREPARATION**

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches (1372 mm) above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
  - 1. Apply 2-inch (50-mm) uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches (150 mm) of tree trunks.

#### **3.3 PROTECTION ZONES**

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
  - 1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
  - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
  - 3. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet (6 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
  - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
  - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

#### **3.4 EXCAVATION**

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Civil Engineer's documents unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

- C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

### 3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as shown on Drawings and as follows:
  - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  - 2. Cut Ends: Do not paint cut root ends.
  - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  - 4. Cover exposed roots with burlap and water regularly.
  - 5. Backfill as soon as possible according to requirements in Civil Engineer's documents.
- B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches (300 mm) outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

### 3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.
  - 1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
  - 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
  - 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
    - a. Type of Pruning: Cleaning where indicated.
- B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and spread over areas identified by Architect.

### 3.7 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

### 3.8 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
  - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
  - 1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 6 inches (150 mm) or smaller in caliper size.

2. Large Trees: Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measures more than 6 inches (150 mm) in caliper size.
    - a. Species: As selected by Architect.
  - C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch (50-mm) uniform thickness to remain.
  - D. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.
- 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

**END OF SECTION**



## SECTION 01 57 13

### EROSION AND SEDIMENTATION CONTROL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes providing temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction. Temporary measures include the following.
  - 1. Silt fences and straw bales.
  - 2. Sediment barriers and check dams.
  - 3. Stabilized construction entrance.
  - 4. Construction of temporary swales and sedimentation basins as required.
  - 5. Seeding, sodding, and hydromulching.
- B. Comply with all local, state, and federal regulations regarding erosion control including the applicable provisions of the National Pollution Discharge Elimination System (NPDES) regulations from the Federal Clean Water Act.
- C. Should any provisions of this section be at variance with erosion control plan prepared by the civil engineer, the civil engineer's directive shall take precedence.

##### 1.2 NOTICE OF INTENT

- A. Contractor and Owner shall jointly submit an EPA Notice of Intent (NOI) prior to construction.
- B. Contractor shall prepare the report, coordinate with Owner, and file in accordance with regulations.

#### PART 2 - PRODUCTS

##### 2.1 SILT FENCE

- A. Filter Fabric: Non-woven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches wide.
  - 1. Basis-of-Design Product: Lundin "Silt Buster," Mirafi "Envirofence" or acceptable substitution.
- B. Wire Fence Support: Welded wire fabric 2 inches by 4 inches - W1.0 by W1.0.
- C. Fence Posts: Painted or galvanized steel Tee or Y-posts with anchor plates, not less than 5 feet in length with a minimum weight of 1.3 pounds per foot. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702.

##### 2.2 STRAW BALES

- A. Standard rectangular hay bales bound by baling wire.

##### 2.3 SEDIMENT TRAPS

- A. Standard manufacture designed to fit the intended inlet.

##### 2.4 STABILIZED CONSTRUCTION ENTRANCE

- A. Aggregate: Graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448 and TEX 401-A coarse-aggregate; with 0 percent being retained by a 5-inch sieve and 100 percent being retained by a 3-inch sieve.

##### 2.5 GRASS

- A. Materials and seeding and sodding shall conform to applicable Division 32 section.

2.6 FERTILIZER

- A. Use commercial grade fertilizers to insure germination and growth. Analysis by weight shall be 16-4-8 or 15-5-10 for Nitrogen, Phosphoric Acid and Potash.

2.7 WATER

- A. Use clean potable water for maintaining the grass.

**PART 3 - EXECUTION**

3.1 GENERAL

- A. Keep disturbed areas to a minimum required to adequately perform the work. At all times maintain the site in such a manner that minimizes erosion of the site. The execution of work under this section shall be in conformance with the NPDES rulings and the site Storm Water Pollution Prevention Plan.

3.2 SILT FENCES

- A. Silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches in the ground, placed a maximum of 8 feet apart and set on a slight angle toward the anticipated runoff source.
  - 1. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.
- B. Securely attach filter fabric to posts and wire support fence, with the bottom 12 inches of filter fabric buried in a trench a minimum of 6 inches deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence.
  - 1. When silt fence is constructed on impervious material, a 12-inch flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss.
  - 2. No horizontal joints will be allowed in the filter fabric.
  - 3. Vertical joints shall be overlapped a minimum of 12 inches with the ends sewn or otherwise securely tied.
- C. Silt fence shall be maintained for the duration of the project, and repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches.

3.3 EROSION CONTROL BARRIERS

- A. Provide erosion control barriers at intervals along swales and ditches as shown on the Drawings or as necessary to meet the requirements of the Storm Water Pollution Prevention Plan.
- B. Barriers: Silt fence or hay bales placed as indicated on the Drawings.
- C. Maintain barriers in good working condition and replace when damaged.

3.4 STABILIZED CONSTRUCTION ENTRANCE

- A. Remove trees, brush, stumps, obstructions, and other objectionable material and disposed of in a manner that will not interfere with the excavation, grading, and construction of the entrance as indicated on the Drawings.
  - 1. Stabilized construction entrance shall not drain onto the public right-of-way and shall not allow surface water runoff to exit the construction site.
  - 2. When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right of way.
    - a. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin.
  - 3. Sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence or other methods approved by the Engineer or designated representative.
- B. The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right of way. Provide periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. Sediment that is spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

### 3.5 TEMPORARY AND PERMANENT SWALES

#### A. Description:

1. Provide temporary and permanent drainage swales as required to carry drainage away from the work area to an approved outfall point.
2. Unless otherwise shown on the drawings, swales shall be earthen "V" shaped channels graded to a sufficient depth and slope to carry the anticipated runoff, but at least 2 feet deep with a slope of 0.1 percent.
3. Swales not designated to remain in place at the completion of the contract shall be cleaned of any muck, debris and other unsuitable material and filled with approved fill before final grading operations begin.
4. Swales shall have erosion control barriers as required.
5. All permanent swales shall be sodded to a minimum width of 10 feet on either side of the centerline of the swale.

#### B. Maintenance:

1. During the course of construction maintain temporary swales constructed for this contract so as to allow proper drainage from the construction area. Before Contractor leaves the site at the end of construction, place temporary swales to remain in good working condition.
2. Work with other contractors at the site in maintaining existing swales and ditches.
3. Where necessary for access to the work areas, install adequately sized culverts and maintain to provide the access without disturbing the site drainage.
4. Take care not to rut and damage sodded swales. Immediately repair damaged swales.
5. Keep sodded swales mowed.

### 3.6 DRAINAGE DITCHES

- A. Immediately hydromulch drainage ditches upon final grading.
- B. Repair erosion of the banks of the drainage ditches immediately and re-stabilize.
- C. Place sediment barriers at intervals along the ditch as shown on the plans or as necessary to help trap sediment on the site. Daily remove sediment and other debris trapped by the barriers.
- D. Maximum Ditch Side Slopes: 3 feet horizontal to 1 foot vertical.
- E. Maintenance of the ditches during construction shall include but not be limited to mowing, re-grading, sediment removal, re-hydromulching, bank repair and debris removal.
- F. Sediment removed from the ditches may be respread on the site as directed by the Owner.

### 3.7 FILL AND CUT SLOPES

- A. Fill slopes in all cases shall be no steeper than 3:1 unless specifically stated on the plans or approved by the Owner's soils engineer.
- B. When cut slopes exceed 2:1 for depths over 3 feet, proper bracing and shoring per OSHA requirements shall be used and maintained.
- C. For permanent slopes, cut or fill, between 2:1 and 10:1, erosion protection shall be provided with hydromulching, sodding, seeding, or other method as approved.

### 3.8 SEDIMENTATION BASINS

#### A. Description:

1. Provide sedimentation ponds where indicated.
2. Route drainage from cleared areas through the sedimentation basin.
3. Operate and maintain the pond during construction.

#### B. Maintenance:

1. Maintain the pond and the outfall and sediment retarding structure in good working condition throughout the time the pond is to be in operation.
2. When sediment and debris fill the pond to over one third (1/3) its designed capacity, clean out the pond.
3. Stockpile, in its' own separate area, the sediment from the clearing operation, or remove from the site, as required. Make adequate drainage provisions such that drainage from the sediment stockpile drains back into the sediment pond. When approved by the Owner, sediment removed from the pond may be spread over the site.

3.9 SEEDING

- A. Seed disturbed portions of the site and stockpile areas within 14 days if the phasing of the construction operations are anticipated to leave those portions of the areas unworked for 21 days or more.
- B. Maintain seeded areas until the project is accepted by the Owner. Maintain by watering, fertilizing, reseeding, mowing and erosion repair as may be required. Cut grass when the average height of the grass reaches 6 inches. Clippings may be mulched back into the seeded areas.

**END OF SECTION**

## **SECTION 01 57 23**

### **TEMPORARY STORM WATER POLLUTION CONTROL**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes: Storm Water Pollution Prevention and Pollution Control Plan as required by the Texas Commission on Environmental Quality (TCEQ), effective March 2023.
- B. Related Sections:  
Section 31 00 00 - EARTHWORK

##### **1.2 QUALITY ASSURANCE**

- A. State Standards: Execution of the Pollution Prevention and the Pollution Control Plan shall meet all requirements set forth by TCEQ under the Texas Pollution Discharge Elimination System (TPDES) regulations.

#### **PART 2 - PRODUCTS**

NOT APPLICABLE.

#### **PART 3 - EXECUTION**

##### **3.1 PERFORMANCE**

- A. General: Implement all the requirements detailed in the Erosion Control Plan and any additional pollution prevention and control measures required by the TCEQ.
- B. The Erosion Control Plan is included as part of the construction plans. The erosion control measures shown on the plans are the minimum required for this project. The contractor shall implement additional erosion control devices as construction sequence and activities dictate.
- C. The SWPPP document (including N.O.I. and N.O.T.) that makes up the balance of the SWPPP shall be prepared by the contractor at his expense. The contractor shall be the Owner/Operator of the SWPPP and responsible for executing and filing the N.O.I. and N.O.T. and paying all fees required by TCEQ.

**END OF SECTION**

## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

##### 1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
- F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.

### 1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
  - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
    - a. Name of product and manufacturer.
    - b. Model and serial number.
    - c. Capacity.
    - d. Speed.
    - e. Ratings.
  - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

### 1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
  - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
  - 2. Store products to allow for inspection and measurement of quantity or counting of units.
  - 3. Store materials in a manner that will not endanger Project structure.
  - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
  - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.
  - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  - 4. Where products are accompanied by the term "as selected," Architect will make selection.
  - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
  - 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
  - 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
  - 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
  - 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.



5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
  6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
    - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
  7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
    - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
  2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 73 00

### EXECUTION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.

##### 1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

##### 1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
  - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
    - a. Contractor's superintendent.
    - b. Trade supervisor responsible for cutting operations.
    - c. Trade supervisor(s) responsible for patching of each type of substrate.
    - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
  - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Layout Conference: Conduct conference at Project site.
  - 1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
    - a. Contractor's superintendent.
    - b. Professional surveyor responsible for performing Project surveying and layout.
    - c. Professional surveyor responsible for performing site survey serving as basis for Project design.
  - 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
  - 3. Review requirements for including layouts on Shop Drawings and other submittals.
  - 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certified Surveys: Submit two copies signed by land surveyor.

- C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
  - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
  - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
  - 4. Dates: Indicate when cutting and patching will be performed.
- E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

#### 1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
  - 2. List of detrimental conditions, including substrates.
  - 3. List of unacceptable installation tolerances.
  - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

#### **3.2 PREPARATION**

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

#### **3.3 CONSTRUCTION LAYOUT**

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

### 3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.

- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.



- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
  - J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.8 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
  - B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
  - C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."
- 3.9 PROTECTION OF INSTALLED CONSTRUCTION
- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
  - B. Comply with manufacturer's written instructions for temperature and relative humidity.
- 3.10 CORRECTION OF THE WORK
- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
    - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
  - B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
  - C. Restore permanent facilities used during construction to their specified condition.
  - D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
  - E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
  - F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

**END OF SECTION**

## SECTION 01 77 00

### CLOSEOUT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.

##### 1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

##### 1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
  - 5. Submit testing, adjusting, and balancing records.
  - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 01 29 00 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
  5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.8 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
  2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.

- b. Date.
- c. Name of Architect.
- d. Name of Contractor.
- e. Page number.
- 4. Submit list of incomplete items in the following format:
  - a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

#### 1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit by uploading to web-based project software site.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### PART 3 - EXECUTION

#### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Remove snow and ice to provide safe access to building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
    - i. Vacuum and mop concrete.
    - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - l. Remove labels that are not permanent.

- m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - r. Clean strainers.
  - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
  - D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- 3.2 REPAIR OF THE WORK
- A. Complete repair and restoration operations required by Section 01 73 00 "Execution" before requesting inspection for determination of Substantial Completion.

**END OF SECTION**

## SECTION 01 78 23

### OPERATION AND MAINTENANCE DATA

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.

##### 1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

##### 1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

#### 1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Architect.
  - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

#### 1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
  - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

#### 1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
  - 1. Type of emergency.
  - 2. Emergency instructions.
  - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  - 1. Fire.
  - 2. Flood.
  - 3. Gas leak.
  - 4. Water leak.
  - 5. Power failure.
  - 6. Water outage.
  - 7. System, subsystem, or equipment failure.

8. Chemical release or spill.
  - D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
  - E. Emergency Procedures: Include the following, as applicable:
    1. Instructions on stopping.
    2. Shutdown instructions for each type of emergency.
    3. Operating instructions for conditions outside normal operating limits.
    4. Required sequences for electric or electronic systems.
    5. Special operating instructions and procedures.
- 1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS
- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
    1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
    2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
  - B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
    1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
    2. Performance and design criteria if Contractor has delegated design responsibility.
    3. Operating standards.
    4. Operating procedures.
    5. Operating logs.
    6. Wiring diagrams.
    7. Control diagrams.
    8. Piped system diagrams.
    9. Precautions against improper use.
    10. License requirements including inspection and renewal dates.
  - C. Descriptions: Include the following:
    1. Product name and model number. Use designations for products indicated on Contract Documents.
    2. Manufacturer's name.
    3. Equipment identification with serial number of each component.
    4. Equipment function.
    5. Operating characteristics.
    6. Limiting conditions.
    7. Performance curves.
    8. Engineering data and tests.
    9. Complete nomenclature and number of replacement parts.
  - D. Operating Procedures: Include the following, as applicable:
    1. Startup procedures.
    2. Equipment or system break-in procedures.
    3. Routine and normal operating instructions.
    4. Regulation and control procedures.
    5. Instructions on stopping.
    6. Normal shutdown instructions.
    7. Seasonal and weekend operating instructions.
    8. Required sequences for electric or electronic systems.
    9. Special operating instructions and procedures.
  - E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
  - F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.



## 1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 78 39

### PROJECT RECORD DOCUMENTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.

##### 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

##### 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.

- m. Field records for variable and concealed conditions.
        - n. Record information on the Work that is shown only schematically.
      3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
      4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
      5. Mark important additional information that was either shown schematically or omitted from original Drawings.
      6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
    - B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
      1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
      2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
      3. Refer instances of uncertainty to Architect for resolution.
      4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
        - a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
        - b. Architect will provide data file layer information. Record markups in separate layers.
    - C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
      1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
      2. Format: Annotated PDF electronic file with comment function enabled.
      3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
      4. Identification: As follows:
        - a. Project name.
        - b. Date.
        - c. Designation "PROJECT RECORD DRAWINGS."
        - d. Name of Architect.
        - e. Name of Contractor.
- 1.4 RECORD SPECIFICATIONS
  - A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
    1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
    2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
    3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
    4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
    5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
  - B. Format: Submit record specifications as annotated PDF electronic file.
- 1.5 RECORD PRODUCT DATA
  - A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
  - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

#### 1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
  - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

#### 1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## SECTION 01 79 00

### DEMONSTRATION AND TRAINING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

##### 1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of videographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date of video recording.
  - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
  - 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

##### 1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.

3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

#### 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

#### 1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.
    - l. Required sequences for electric or electronic systems.
    - m. Special operating instructions and procedures.

5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

#### 1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

#### 1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Owner will furnish an instructor to describe Owner's operational philosophy.
  2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

#### 1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  1. At beginning of each training module, record each chart containing learning objective and lesson outline.



- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
  - 1. Submit video recordings on CD-ROM or thumb drive.
  - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
  - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
  - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
  - 1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
  - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 02 41 19**  
**SELECTIVE DEMOLITION**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove, Salvage, and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

### 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

### 1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

### 1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
  - 1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off utilities with utility companies.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - d. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

### 3.4 PROTECTION

- A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain fire watch during and for at least two hours after flame-cutting operations.
  - 6. Maintain adequate ventilation when using cutting torches.
  - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  - 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

- C. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area on-site .
  - 5. Protect items from damage during transport and storage.
- D. Salvaged Materials for Reinstallation:
  - 1. Clean and repair items to functional condition adequate for intended reuse.
  - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
  - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
  - 2. Remove existing roofing system down to substrate.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

**END OF SECTION**

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings, grade beams, drilled piers.
  - 2. Slabs-on-void-forms
  - 3. Slabs-on-metal-deck
  - 4. Walls.

##### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with fly ash; subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures each with its own identification number when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Indicate the minimum following information:
  - 1. Mix Identification Number.
  - 2. Mix-use type.
  - 3. Required 28-day compressive strength.
  - 4. Cement content.
  - 5. Coarse aggregate type and quantity.
  - 6. Fine aggregate type and quantity.
  - 7. Total aggregate gradation.
  - 8. Water quantity.
  - 9. Admixture types and quantity.
  - 10. Slump measurement.
  - 11. Air content.
  - 12. 28-day shrinkage rate.
  - 13. 28-day concrete strength test.
  - 14. Alkali Silicate Reactivity (ASR).
  - 15. Chloride-ion content.
  - 16. Amounts of mixing water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, licensed in the state which the project is located, detailing fabrication, assembly, and support of formwork.
- F. Concrete Slab Plans:
  - 1. Indicate all construction, contraction, control and expansion joints, as well as proposed start and stop of concrete pour joints.
  - 2. Indicate all sloped slab areas at floor drains. Label depth of floor drain and shape/ extent of sloped area surrounding drain.
  - 3. Indicate all slab recess areas. Dimension extents in plan, and depth of recess.
- G. Welding certificates.
- H. Qualification Data: For manufacturer and testing agency.

- I. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
    - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
  - J. Material Certificates: For each of the following, signed by manufacturers:
    - 1. Cementitious materials.
    - 2. Admixtures.
    - 3. Form materials and form-release agents.
    - 4. Steel reinforcement and accessories.
    - 5. Waterstops.
    - 6. Curing compounds.
    - 7. Bonding agents.
    - 8. Adhesives.
    - 9. Vapor retarders.
    - 10. Semi-rigid joint filler.
    - 11. Joint-filler strips.
    - 12. Repair materials.
  - K. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
  - L. Field quality-control test reports.
  - M. Minutes of preinstallation conference.
- 1.4 QUALITY ASSURANCE
- A. Installer of concrete topping slabs indicated to receive polished concrete finish and structural cast-in-place concrete slab shall be the same as installer for polished concrete finishes.
  - B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
    - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
  - C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
    - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
    - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
  - D. Moisture Vapor Reduction Admixture Testing Agent Qualifications:
    - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
  - E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
  - F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
    - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5."
    - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  - H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
  - I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Sections.
    - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      - a. Contractor's superintendent.
      - b. Independent testing agency responsible for concrete design mixtures.
      - c. Ready-mix concrete manufacturer.

- d. Concrete subcontractor.
  - e. Architect.
  - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.
  - J. Protection: No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential. Protect areas to receive a sealed concrete finish during construction to prevent oils, dirt, metal, excessive water and other damaging materials from affecting the finished concrete surface. Protection measures listed below shall begin immediately after the concrete slab is poured:
    - 1. Hydraulic powered equipment shall be diapered to avoid staining of the concrete.
    - 2. Vehicle parking shall be prohibited on the finish slab area. If necessary to complete their scope of work, drop cloths shall be placed under vehicles at all times.
    - 3. No pipe cutting machine shall be used on the finish floor slab.
    - 4. Steel shall not be placed on the finish slab to avoid rusting.
    - 5. Acids and acidic detergents will not come in contact with slab.
    - 6. All equipment used on the finish slab shall be equipped with non-marking tires.
    - 7. Painters shall use drop cloths on the concrete. Remove paint stains immediately.
    - 8. Construction trades shall be informed that the slab must be protected at all times.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
  - B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- 1.6 WARRANTY
- A. Moisture Vapor Reduction Admixture (MVRA):
    - 1. MVRA must be installed according to, and in compliance with, the manufacturer's published data sheet to include, but not limited to:
      - a. Dosing instructions.
      - b. Onsite representation requirements.
      - c. Use of an ASTM E 1745 vapor retarder installed following ASTM E 1643 and ASTM F710 guidelines.
    - 2. Manufacturer's Warranty: To include:
      - a. Term: Life of the concrete.
      - b. Repair and/or removal of failed flooring or roofing.
      - c. Placement of a topical moisture remediation system.
      - d. Replacement of flooring/roofing materials like original installed to include material and labor.
    - 3. Adhesion Warranty: MVRA Manufacturer shall provide an adhesion warranty to match the term of the adhesive and/or primer manufacturer's material defect warranty upon MVRA manufacturer's acceptance of field bond test.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### **2.2 CONCRETE, GENERAL**

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301.



2. ACI 117.

2.3 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Plywood, metal, or other approved panel materials.
  - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - a. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Pedestals and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation. Provide fiber tubes that produce surfaces without spiral or vertical seams.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
- H. Nails and Fasteners:
  - 1. Use only galvanized nails and fasteners for securing formwork.

2.4 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Wire: ASTM A 82, as drawn.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.5 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
  - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.6 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following for concrete other than slabs and flatwork:
    - a. Fly Ash: ASTM C 618, Class C.

- B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Coarse aggregate shall be from a source and ledge approved by Missouri Department of Transportation.
  - 1. Maximum Coarse-Aggregate Size: As indicated.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

## 2.7 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Moisture Vapor Reduction Admixture: For use in all interior slabs on ground.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Barrier One Incorporated; High Performance Concrete Admixture or comparable product by one of the following:
    - a. Concure Systems; High Performance Concrete Admixture.
    - b. ISE Logik Industries; MVRA 900 Admixture.
    - c. Moxie; Shield 1800 Admixture.
    - d. The Specialty Products Group; Vapor Lock 20/20.
    - e. Failure to provide a product that meets or exceeds the MVRA warranty requirements of Part 1 and the MVRA field quality control requirements of Part 3 will result in all subsequent testing and slab remediation costs being born by the ready mix supplier.
  - 2. Description: Concrete moisture vapor reduction admixture for all interior slabs on ground shall be a non-toxic liquid admixture specifically designed to have a natural chemical reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through the slab by restricting the integral capillary system. Chemical reaction shall form a permanent barrier (capillary break) that is integral to the concrete, insoluble, and irremovable.

## 2.8 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
    - b. Concrete Sealants Inc.; Conseal CS-231.
    - c. Greenstreak; Swellstop.
    - d. Henry Company, Sealants Division; Hydro-Flex.
    - e. JP Specialties, Inc.; Earthshield Type 20.
    - f. Progress Unlimited, Inc.; Superstop.
    - g. TCMiraDRI; Mirastop.

## 2.9 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fortifiber Corporation; Moistop Ultra, 15 mils.
    - b. Raven Industries Inc.; Vapor Block, 15 mils.
    - c. Stego Industries, LLC; Stego Wrap, 15 mils.
    - d. Insulation Solutions, Inc.; Viper Vaporcheck, 16 mils.

- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve placed below the vapor retarder.
  - 1. Install and compact at 4 inches minimum depth, unless otherwise indicated on the Drawings.

## 2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Axim Concrete Technologies; Cimfilm.
    - b. Burke by Edoco; BurkeFilm.
    - c. ChemMasters; Spray-Film.
    - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
    - e. Dayton Superior Corporation; Sure Film.
    - f. Euclid Chemical Company (The); Eucobar.
    - g. Kaufman Products, Inc.; Vapor Aid.
    - h. Lambert Corporation; Lambco Skin.
    - i. L&M Construction Chemicals, Inc.; E-Con.
    - j. MBT Protection and Repair, Div. of ChemRex; Confilm.
    - k. Meadows, W. R., Inc.; Sealtight Evapre.
    - l. Metalcrete Industries; Waterhold.
    - m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
    - n. Sika Corporation, Inc.; SikaFilm.
    - o. Spec Chem; Spec Film RTU.
    - p. Symons Corporation, a Dayton Superior Company; Finishing Aid.
    - q. Unitex; Pro-Film.
    - r. US Mix Products Company; US Spec Monofilm ER.
    - s. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    - b. Burke by Edoco; Aqua Resin Cure.
    - c. ChemMasters; Safe-Cure Clear.
    - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; W.B. Resin Cure.
    - e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
    - f. Euclid Chemical Company (The); Kurez DR VOX.
    - g. Kaufman Products, Inc.; Thinfilm 420.
    - h. Lambert Corporation; Aqua Kure-Clear.
    - i. L&M Construction Chemicals, Inc.; L&M Cure R.
    - j. Meadows, W. R., Inc.; 1100 Clear.
    - k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
    - l. Spec Chem; Spec REZ.
    - m. Symons Corporation, a Dayton Superior Company; Resi-Chem Clear Cure.
    - n. Tamms Industries, Inc.; Horncure WB 30.
    - o. Unitex; Hydro Cure 309.
    - p. US Mix Products Company; US Spec Maxcure Resin Clear.
    - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

## 2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

- D. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

#### 2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- C. Repair Mortar for precast concrete panel joints: Dayton-Superior "Waterstop" hydraulic cement repair mortar, or equal

#### 2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Provide percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 15 percent for foundations and walls.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.3 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

#### 2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixtures to equal or exceed the minimum 28 day concrete compressive strength and other specified criteria indicated on the drawings.
- B. Slabs-on-grade: Comply with Paragraph 2.16.A and as follows:
  - 1. Moisture Vapor Reduction Admixture: Dose at 14 ounces per 100 pounds of total cementitious materials. Remove an equal amount of water from the mix. Add separately from other admixtures at the tail end of the load.

#### 2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

**PART 3 - EXECUTION**

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
  - 2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 1. Install keyways, reglets, recesses, and the like, for easy removal.
  - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
  - 1. Leave formwork for structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 VOID FORMS

- A. Product of a reputable manufacturer regularly engaged in commercial production of void forms for the purpose of providing void space below foundation elements as protection from subgrade movement.
  - 1. Void forms shall be capable of supporting required dead load of wet concrete plus normal construction loads until applied loads can be supported by concrete structure, while maintaining full void depth as indicated on drawings.
  - 2. Void forms shall be manufactured with corrugated material with a moisture resistant exterior, an interior fabrication of a uniform, cellular configuration composed of non-wax impregnated components, and shall be biodegradable.
  - 3. Depth: As indicated on drawings.
  - 4. Profile: As indicated on drawings.
    - a. select one of following cross-sections based on geotechnical recommendations. generally, rectangular profile should be specified along with void retainers, unless geotechnical engineer specifically states allowance for trapezoidal void forms in geotech report.
    - b. Rectangular in cross-section. (Trapezoidal sections are not permitted)
  - 5. select/edit required strength of carton forms. use 6 to 8 times concrete weight for slabs. use 1.5 to 2 times concrete weight for grade beams and walls. carton form strengths available are 500 to 5000 psf. intent should be to not over-specify strength as carton forms must decay. stronger units require more time to decay.
  - 6. Strength: Capable of supporting a working load as indicated below, in dry condition, (as evidence by Independent Testing Laboratory Tests).
    - a. 3,000 psf.
- B. Void Retainer Units: Precast concrete units with 28-day compressive strength (f<sub>c</sub>) not less than 2,500 psi, reinforced with 6x6-W1.4xW1.4 W.W.F., with following minimum dimensions for individual units, unless otherwise noted on drawings. Thickness = 1-5/8 in (40 mm); Length = 3 ft (.9 m); Unless otherwise indicated on Drawings or specified, height not less than carton/void height plus 6 in (150 mm). Do not substitute trapezoidal carton forms for carton forms specified to receive void retainer units.
  - 1. Acceptable option to above precast concrete units for void retention: "SureRetainer" as manufactured by SureVoid Products, Inc. Depth and installation as recommended by manufacturer to ensure soil retention for specified carton form depth. Submit size and installation instructions for approval prior to use.

### 3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
  - 2. Seal around all penetrations with manufacturer's recommended tape.

### 3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
  - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset
- F. laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  - 6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.8 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

### 3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
  - C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and if specifically approved by the Architect.
    - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
  - D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
    - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
    - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
    - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
  - E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
    - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
    - 2. Maintain reinforcement in position on chairs during concrete placement.
    - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
    - 4. Slope surfaces uniformly to drains where required.
    - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
  - F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
    - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
    - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
    - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
  - G. Hot-Weather Placement: Comply with ACI 301 and as follows:
    - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
    - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- 3.10 FINISHING FORMED SURFACES
- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
    - 1. Apply to concrete surfaces not exposed to public view such as mechanical rooms and storage rooms where cast-in-place concrete walls occur.
  - B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes, defects and voids larger than 3/4 inch wide or 1/2 inch deep. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
    - 1. Apply to concrete surfaces exposed to public view.



- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull- floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.
  - 1. Apply scratch finish to surfaces to receive concrete floor toppings.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film- finish coating system.
  - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on- grade with carpet, ceramic tile, sheet flooring, vinyl tile and other thin flooring materials, and at areas with no floor covering.
    - b. Specified overall values of flatness, F(F) 50; and of levelness, F(L) 40; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 35; for gymnasiums.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in- place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
  - 1. Construct concrete bases 4 inches ((100 mm)) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

### 3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Cure concrete surfaces to receive floor coverings with a moisture-retaining cover.
  - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

### 3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- D. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
- E. Apply concrete repair mortar to base of precast panels per detail and manufacturer recommendations.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
  5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.16 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner shall engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
  2. Steel reinforcement welding.
  3. Headed bolts and studs.
  4. Verification of use of required design mixture.
  5. Concrete placement, including conveying and depositing.
  6. Curing procedures and maintenance of curing temperature.
  7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
    - b. Either 6-inch diameter by 12-inch cylinders or 4-inch diameter by 8-inch cylinders are acceptable.
    - c. Cylinder diameter shall be at least three times the nominal maximum coarse aggregate size if the mix being tested.
    - d. All cylinders of a class of concrete shall be the same size.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method at point of placement, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  6. Compression Test Specimens: ASTM C 31/C 31M.
    - a. A set of test cylinders shall consist of a minimum of four standard cylinder specimens for each composite sample. The number per set may be greater depending on the cylinder sizes.
  7. Compressive-Strength Tests: ASTM C 39/C 39M; test one cylinder of the laboratory- cured specimens at 7 days and one set of at least two cylinders at 28 days.
    - a. Test one cylinder of a set at 7 days and one set of two 6" by 12" cylinders or three 4" by 8" cylinders at 28 days.
    - b. One cylinder shall be retained in reserve to be tested as directed by the Engineer.
    - c. A compressive-strength test shall be the average compressive strength from a set of at least two cylinders obtained from the same composite sample and tested at age indicated.
  8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa). Maintenance of test data records required for evaluation and acceptance of concrete strengths per ACI 318 shall be by the Contractor.
  9. When the aforementioned acceptance criteria are not met the Contractor shall evaluate operations and steps shall be taken to increase the average of subsequent strength test results.
  10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
  13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Testing of Slabs Containing MVRA:
1. The moisture vapor reduction admixture (MVRA) manufacturer will perform all moisture testing in accordance with this specification and will issue project specific warranties prior to installation of any slab finishes; no further field slab moisture nor pH testing shall be required.
    - a. Failure to provide a product that meets or exceeds these requirements will result in all subsequent testing and slab remediation costs being borne by the contractor.
  2. A representative or agent of the moisture vapor reduction admixture (MVRA) manufacturer must be present at the jobsite during placement of all MVRA treated concrete. Do not proceed without this representative being present.
  3. Field testing technician shall, at the expense of the MVRA Manufacturer, procure at least one 4 inch (102 mm) cylinder from every day of placement of MVRA dosed concrete for the purpose of subsequent hydraulic conductivity/coefficient of permeability testing.
  4. All cylinders shall be independently lab tested in accordance with ASTM D 5084 at the expense of the MVRA manufacturer.

5. Test results must conform to specified limits.
  - a. Should any cylinder from any day of placement deliver results in excess of  $6.0 \times 10^{-8}$  cm/sec, the concrete moisture vapor reduction admixture manufacturer shall procure, at their expense, a core (or cores) from that day of placement. This core (cores) shall be sent to an independent laboratory for hydraulic conductivity (coefficient or permeability) per ASTM D 5084.
  - b. Should any core deliver results in excess of  $6.0 \times 10^{-8}$  cm/sec per ASTM D 5084, the concrete moisture vapor reduction admixture manufacturer shall provide, at their expense, a topical moisture mitigation system for all areas not meeting the stated limit.
6. Proceeding with placement of concrete dosed with the MVRA without the required representation will result in the contractor bearing the cost to core and ship appropriate material for testing per ASTM D 5084.

END OF SECTION 03 30 00

## SECTION 03 30 35

### UNDER SLAB SHEET VAPOR RETARDER

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Sheet materials for controlling vapor diffusion through concrete slabs-on-grade.

##### 1.2 SUBMITTALS

- A. Written certification from the manufacturer that the materials and their application as noted in this Specification and on the Drawings is appropriate and approved for this project.
- B. Product Data: Manufacturer's product data, specifications, and installation instructions. Include vapor barrier manufacturer's requirements for placement, seaming and pipe book installation.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Submit evidence that Installer's existing company has minimum of 5-years continuous experience in application of specified materials.

##### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer (applicator) who is acceptable to manufacturer, who has completed applications similar in material and extent to that required for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Vapor barrier and components to be from one source from a single manufacturer.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and application.
- B. Store materials in a clean dry location in accordance with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
- C. Stack membrane on elevated wood platform to eliminate warping.
- D. Protect materials during handling and application to prevent damage or contamination.

##### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written recommendations for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting materials performance. Do not apply on frozen ground.
- B. Close areas to traffic during application and for time period after application recommended in writing by manufacturer.

##### 1.6 COORDINATION

- A. Coordinate placement of sheet vapor barrier with Division 03 concrete sections.
- B. Coordinate placement of sealer and hardener with Division 03 concrete sections and with requirements of finish flooring products, including adhesives, specified in Division 09 Sections.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Sheet Vapor Barrier:
  - 1. Type: 15 mil polyolefin film meeting requirements of ASTM E 1745, Class A.
  - 2. Performance Requirements:
    - a. Maintain permeance of less than 0.01 Perms [grains/(ft<sup>2</sup> · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).

- b. Strength: ASTM E 1745: Class A.
  3. Provide third party documentation that testing was performed on a single production roll per ASTM E1745 Section 8.1
- B. Products for Use on Grade: Subject to compliance with requirements, provide one of the following:
  1. Fortifiber Building Systems Group; Moistop Ultra 15.
  2. Meadows, W. R., Inc.; Perminator 15 mil.
  3. Raven Industries Inc.; VaporBlock 15.
  4. Stego Industries, LLC; Stego Wrap 15 mil Class A.
- C. Basis-of-Design Product: Stego Industries, LLC; Stego Wrap 15 mil Class A.
- D. Products for Use with Void Box Systems: Subject to compliance with requirements, provide one of the following:
  - a. GCP Applied Technologies, Inc.; Florprufe 120.
  - b. Polyguard Products, Inc.; Underseal Underslab Membrane.
  - c. Stego Industries, LLC; Stego Wrap 15 mil Class A with Stego Crete Claw Tape 6 Inches.
    - 1) Accessories:
      - a) Seams: Stego Industries, LLC; Stego Crete Claw Tape 6 Inches.
      - b) Sealing Penetrations of Vapor Barrier: Stego Industries, LLC; Stego Mastic and Stego Tape.
      - c) Perimeter / Terminated Edge Seal: Stego Industries, LLC; Stego Crete Claw 6 Inches.
      - d) Penetration Prevention: Stego Industries, LLC; Beast Foot and Beast Form Stake.
      - e) Vapor Barrier-Safe Screed System: Stego Industries, LLC; Beast Screed.
- E. Accessories:
  1. Bonding Agent: Manufacturer's approved or recommended vapor barrier bonding agent.
  2. Sealing and Seaming Tape: High density polyethylene tape a minimum of 4 inches in width, compatible with vapor barrier membrane, and manufactured by or recommended by vapor barrier membrane manufacturer. Tape for joints shall have at least the same permeability rating as the vapor barrier specified.
  3. Vapor Proofing Mastic: Manufacturer's approved or recommended vapor proofing mastic with the same permeability rating as the vapor barrier specified.
  4. Pipe Boot: Construct pipe boots from vapor barrier material and pressure sensitive tape in accordance with manufacturer's instructions.
  5. Tape for Adhering Vapor Barrier to Concrete: 6-inch wide, double-sided, multi-layered tape allowing wet concrete to cast into the textured top surface forming a mechanical bond.
    - a. Basis-of-Design Product: Stego Industries, LLC.; Stego Crete Claw Tape 6".

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine surfaces to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

#### **3.2 PREPARATION**

- A. Level or tamp or roll aggregate, sand or granular base.

#### **3.3 INSTALLATION**

- A. Vapor Barrier:
  1. Place, protect, and repair vapor barrier sheets according to ASTM E 1643 and manufacturer's written instructions.
  2. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete pour.
  3. Extend vapor barrier to the perimeter of the slab. If practicable, terminate vapor barrier at top of slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At point of termination, seal vapor barrier to slab using double-sided tape specified above, per manufacturer's instructions.

- a. Seal vapor barrier to the entire slab perimeter using Stego Crete Claw Tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.
  4. Install vapor barrier without tears, voids, and holes. Lap ends and edges as recommended by manufacturer, but not less than 6 inches over adjacent sheets. Seal laps with tape.
  5. Turn up sheets at perimeter, at footings and vertical walls, and against penetrations, and seal joints with tape.
  6. Seal joints, tears, holes, perimeter, and penetrations through vapor with tape in accordance with manufacturer's recommendations.
  7. Point exposed edges with pointing mastic to prevent water from traveling under membrane.
  8. Adhere membrane to vertical surfaces with adhesive.
- 3.4 PROTECTION
- A. Protect complete membrane from damage. Prior to pouring concrete, inspect membrane for punctures or damage and repair as required to maintain vapor barrier integrity.

**END OF SECTION**



## SECTION 03 35 43

### POLISHED CONCRETE FINISHING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Polished concrete finishing, including cleaning of new concrete slabs, scoring, dry grinding to remove surface imperfections and irregularities, and application of hardener and colored dyes.
  - 2. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Polished Concrete Floor Finish: A multi-step finishing process on concrete floor surfaces, consisting of dry grinding and polishing to the scheduled reflective sheen.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Completed polished concrete floor surface shall have a static Coefficient of Friction or Slip Coefficient of 0.6, minimum, when tested in accordance with NFSI Test Method 101A.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Cast-in-place concrete subcontractor.
    - e. Polished concrete finishing Subcontractor.
  - 2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
- C. Samples for Verification: For each type of exposed color.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Repair materials.
  - 2. Stain materials.
  - 3. Liquid floor treatments.
- B. Manufacturer's Instructions: Indicate complete preparation and finishing instructions for each level of sheen.
- C. Maintenance Data: Indicate manufacturer's recommended cleaning and maintenance instructions for polished concrete floor finish.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this Section and trained by equipment manufacturer in proper operation of equipment; successfully completed not less than 3 previous projects of similar scope.

- B. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches (1200 by 1200 mm) minimum, to demonstrate the expected range of finish, color, and appearance variations.
  - 1. Locate panels as indicated or, if not indicated, as directed by Architect.
  - 2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Demolish and remove field sample panels when directed.

#### 1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Take precautions to prevent staining of concrete prior to application of concrete floor polishing.
- C. Prohibit parking of vehicles on concrete slab.
- D. If construction equipment must be used for application, diaper components that might drip oil, hydraulic fluid, or other liquids.
- E. Prohibit acids and acidic detergents from contacting concrete surfaces.
- F. Sequence application of concrete polishing after completion of other construction activities that would be damaging to completed polished finish.

### PART 2 - PRODUCTS

#### 2.1 HARDENING/SEALING MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Advanced Floor Products, Inc.; Retro-Plate 99.
  - 2. American Concrete Technologies, Inc.; Everhard Densifier.
  - 3. Bomanite; VitraFlor/Stabilizer Pro.
  - 4. CureCrete; Ashford Formula.
  - 5. L&M Construction Chemicals; FGS PermaShine.
  - 6. Prosoco; Consolideck.
- B. Basis-of-Design Product: Advanced Floor Products, Inc.; Retro-Plate 99.

#### 2.2 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Advanced Floor Products; RetroPlate Concrete Polishing System (VOC: 0 g/L).
    - b. ARDEX Americas; ARDEX PC 50 (VOC: <50 g/L).
    - c. Laticrete International, Inc.; FGS Permashine (VOC: 0 g/L).
    - d. NewLook International, Inc.; NanoSet Densifier LI (VOC: 0 g/L).
    - e. PROSOCO, Inc.; Consolideck Blended Densifier (VOC: 0 g/L).
    - f. Vexcon Chemicals Inc.; Certi Shine Clear (VOC: 0 g/L).

#### 2.3 ACCESSORY MATERIALS

- A. Acceptable Control Joint Filler:
  - 1. Metzger McGuire MM 80 epoxy joint filler.
  - 2. Hi-Tech Structural Systems Polyurea Joint Filler HT-PE85.
- B. Self-Leveling Underlayment: As recommended by system manufacturer for use in areas requiring deep grinding to remove deep surface imperfections.

### PART 3 - EXECUTION

#### 3.1 POLISHING

- A. Polish: Level 1: Matte finish, 100 grit.

- B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
  - 1. Machine grind floor surfaces to receive polished finishes level and smooth.
  - 2. Apply dye for polished concrete in polishing sequence and according to manufacturer's written instructions.
  - 3. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
  - 4. Control and dispose of waste products produced by grinding and polishing operations.
  - 5. Neutralize and clean polished floor surfaces.

**END OF SECTION**

## SECTION 03 54 16

### HYDRAULIC CEMENT UNDERLAYMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

##### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

##### 1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
  - 1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

#### PART 2 - PRODUCTS

##### 2.1 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.
  - 1. Products Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ARDEX; K-15 Self-Leveling Underlayment Concrete.
    - b. Dayton Superior Corporation; Levelayer.
    - c. MAPEI Corporation; Ultraplan Easy.
    - d. Maxxon Corporation; Level-Right.
    - e. Specialty Construction Brands, Inc.; an H.B. Fuller company; TEC Smooth Start.
- B. Cement Binder: ASTM C 150/C 150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
- C. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- D. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
  - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- E. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- F. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
  - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

#### **3.3 APPLICATION**

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
  - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
  - 2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
  - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply underlayment to produce uniform, level surface.
  - 1. Apply a final layer without aggregate to product surface.
  - 2. Feather edges to match adjacent floor elevations.
- C. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- D. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- E. Apply surface sealer at rate recommended by manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

#### **3.4 PROTECTION**

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

**END OF SECTION**

## SECTION 04 20 00

### UNIT MASONRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Lintels.
  - 2. Brick.
  - 3. Mortar and grout materials.
  - 4. Reinforcement.
  - 5. Ties and anchors.
  - 6. Embedded flashing.
  - 7. Accessories.
  - 8. Mortar and grout mixes.
- B. Products Installed but not Furnished under This Section:
  - 1. Steel lintels in unit masonry.
  - 2. Steel shelf angles for supporting unit masonry.
  - 3. Cavity wall insulation adhered to masonry backup.

##### 1.2 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
  - 2. Show locations of control joints including additional proposed locations that may not be indicated on the Drawings.
  - 3. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R.
  - 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
  - 1. Clay face brick, in the form of straps of five or more bricks.
  - 2. Colored mortar.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of the following:
  - 1. Masonry units.
    - a. Include data on material properties.
    - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
  - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
  - 3. Mortar admixtures.
  - 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 5. Grout mixes. Include description of type and proportions of ingredients.
  - 6. Reinforcing bars.
  - 7. Joint reinforcement.
  - 8. Anchors, ties, and metal accessories.

- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
  - 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- C. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

#### 1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.

#### 1.7 MOCKUPS

- A. Wall Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects to set quality standards for materials and execution and to set quality standards for installation.
  - 1. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches (1524 mm) long by 48 inches (1219 mm) high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 16 inches (406 mm) long in each mockup.
    - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (305 mm) wide by 16 inches (406 mm) high.
    - c. Include through-wall flashing installed for a 24-inch (610-mm) length in corner of exterior wall mockup approximately 16 inches (406 mm) down from top of mockup, with a 12-inch (305-mm) length of flashing left exposed to view (omit masonry above half of flashing).
    - d. Include studs, sheathing, water-resistive barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
  - 2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
  - 3. Protect accepted mockups from the elements with weather-resistant membrane.
  - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations by Change Order.
  - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches (610 mm) down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe, and hold cover in place.

- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain exposed masonry units and mortar aggregate from single source.
- B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
  - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602.
  - 2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

### **2.3 UNIT MASONRY, GENERAL**

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units are listed by UL or a qualified testing agency acceptable to authorities having jurisdiction.

### **2.4 LINTELS**

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

### **2.5 BRICK**

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.



2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBS.
1. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.
  2. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
  3. Size and Face Texture: As scheduled.
  4. Colors: As selected by Architect from the following to match District color standards:
    - a. Village.
    - b. Burgundy.
    - c. Weatherwood Gray.
  5. Application: Use where brick is exposed unless otherwise indicated.
- C. Perforated Clay Face Brick: Complying with ASTM C216.
1. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.
  2. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
  3. Size and Face Texture: As scheduled.
  4. Colors: As selected by Architect from the following to match District color standards:
    - a. Village.
    - b. Burgundy.
    - c. Weatherwood Gray.
- 2.6 MORTAR AND GROUT MATERIALS
- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C1329/C1329M.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
    - a. Davis Colors; True Tone Mortar Colors.
    - b. Euclid Chemical Company (The); an RPM company; Increte Color-Crete Mortar Colors.
    - c. LANXESS Corporation; Bayferrox Iron Oxide Pigments.
    - d. Solomon Colors, Inc; Solomon Colors Mortar Colors.
- F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Portland Cement-Lime Mix:
  2. Colored Masonry Cement:
  3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Heidelberg Materials.
    - b. Holcim (US) Inc.
  5. Pigments do not exceed 10 percent of portland cement by weight.
  6. Pigments do not exceed 5 percent of masonry cement by weight.

- G. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, sand, mortar pigments, and admixtures and complying with ASTM C1714/C1714M.
    - 1. Preblended Dry Portland Cement Mortar Mix:
    - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Cemex S.A.B. de C.V.
      - b. Holcim (US) Inc.
      - c. Heidelberg Materials.
  - H. Aggregate for Mortar: ASTM C144.
    - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
    - 2. For joints less than 1/4 inch (6.4 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
    - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
    - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
  - I. Aggregate for Grout: ASTM C404.
  - J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
    - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Master Builders Solutions; MasterSet FP 20.
      - b. Euclid Chemical Company (The); an RPM International company; ACCELGUARD 80.
      - c. GCP Applied Technologies Inc., MORSET.
  - K. Water: Potable.
- 2.7 REINFORCEMENT
- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
  - B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Dur-O-Wal; a Hohmann & Barnard company.
      - b. Heckmann Building Products, Inc.
      - c. Hohmann & Barnard, Inc.
      - d. Wire-Bond.
  - C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
    - 1. Interior Walls: Hot-dip galvanized carbon steel.
    - 2. Exterior Walls: Hot-dip galvanized carbon steel.
    - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
    - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
    - 5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
    - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (406 mm) o.c.
    - 7. Provide in lengths of not less than 10 ft. (3 m), with prefabricated corner and tee units.
  - D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
  - E. Masonry-Joint Reinforcement for Multi-wythe Masonry:
    - 1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches (102 mm) wide, plus one side rod at each wythe of masonry 4 inches (102 mm) wide or less.
- 2.8 TIES AND ANCHORS
- A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
  2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
  3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
  4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Corrugated-Metal Ties: Not allowed.
- D. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf (445 N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.6 mm).
  2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.1084-inch- (2.75-mm-) thick steel sheet, galvanized after fabrication.
  3. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
  4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs. Where continuous insulation is shown, provide anchor portion with tabs to prevent crushing of insulation when installed.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hohmann & Barnard, Inc.
      - 2) Wire-Bond.
  5. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83 mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours in accordance with ASTM B117.

## 2.9 EMBEDDED FLASHING

- A. Flexible Flashing: Use the following unless otherwise indicated:
1. Self-Adhering, Stainless Steel Flashing: Composite, flashing product consisting of 2 mil (0.05 mm) of Type 304 stainless steel sheet, bonded to a layer of butyl, to produce an overall thickness of 12 mils.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) GE Silicones, Inc.; GE Elemax SS Flashing.
      - 2) Vapro Shield, Inc.; VaproThru-Wall Flashing SA.
      - 3) York Manufacturing, Inc.; York 304 SA SS.
    - b. Basis-of-Design Product: York Manufacturing, Inc.; York 304 SA SS.
    - c. Characteristics:
      - 1) Type: Stainless steel core with one uncoated (bare) stainless steel face (outward facing) with a butyl block copolymer adhesive (inward facing).
      - 2) Stainless Steel: type 304, ASTM A240. Domestically sourced per DFARS 252.225-7008 and/or DFARS 252.225-7009.
      - 3) Adhesive: Block copolymer.
      - 4) No primer required.
      - 5) UV resistant.
      - 6) 20-year warranty.
      - 7) Fire Resistant: ASTM E84 Class A material.
      - 8) Mold Resistant: Passes ASTM D3273.
      - 9) Passes AAMA 711-20.
      - 10) Passes Air Barrier Material Test: ASTM E2178-13.
      - 11) Size: Manufacturer's standard width rolls.

- d. Accessories:
  - 1) Polyether Sealant:
    - a) York Manufacturing, Inc.; UniverSeal US-100.
    - b) STS Coatings; GreatSeal LT-100.
    - c) Prosoco, Inc.; R-Guard Joint Seam Sealer.
  - 2) Splice Tape:
    - a) York Manufacturing, Inc.; York 304 SA
    - b) GE Silicones, Inc.; GE Elemax SS Flashing
    - c) VaproShield, Inc.; Vapro Thru-Wall Flashing SA.
  - 3) Corner and End Dams: Form stainless steel flashing in field or use 26-gauge stainless steel pre-manufactured corners.
  - 4) Mortar Deflection: Polyester strands that will not degrade and keep weep vents from clogging with mortar.
    - a) Basis-of-Design Product: York Manufacturing; Weep-Armor.
- e. Termination Bar: Stainless steel termination bar with sealant catch lip.
  - 1) Basis-of-Design Product: York Manufacturing, Inc.; SS Term Bar.
- B. Termination Bars for Flexible Flashing: Stainless steel bars 0.075 inch by 1 inch (1.90 mm by 25 mm).
- C. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) with a 3/8-inch (10-mm) flange at top.

## 2.10 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vents: Use the following unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Heckmann Building Products, Inc.; Cell Vent No. 85.
      - 2) Hohmann & Barnard, Inc.; QV Quadro-Vent.
      - 3) Wire-Bond; #3601 Cell Vent.
      - 4) Mortar Net Solutions; CellVent.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Mortar Deflector: Strips, 1 inch (25 mm) and 10 inches (254 mm) high, with dovetail-shaped notches that prevent clogging with mortar droppings.
  - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Heckmann Building Products, Inc.; #84 Weep-Thru Mortar Deflector.
    - b. Hohmann & Barnard, Inc.; Mortar Trap.
    - c. Mortar Net Solutions; MortarNet.
    - d. Wire-Bond; Cavity Net DT (3611D).
- F. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Diedrich Technologies, Inc., a Hohmann & Barnard company.
    - b. EaCo Chem, Inc.
    - c. PROSOCO, Inc.

## 2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
  - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For masonry below grade or in contact with earth, use Type M.
  - 2. For reinforced masonry, use Type S.
  - 3. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  - 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
  - 1. Pigments do not exceed 10 percent of portland cement by weight.
  - 2. Pigments do not exceed 5 percent of masonry cement by weight.
  - 3. Mix to match Architect's sample.
- E. Grout for Unit Masonry: Comply with ASTM C476.
  - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
  - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured in accordance with ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
  - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
  - 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
  - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
  - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3.2 mm).
  - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6.4 mm).
  - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).
  - 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.

- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (102 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
  - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive air barriers unless otherwise indicated.

### 3.6 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  - 2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 3. Space anchors as indicated, with not less than one anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
  - 4. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 25 inches (635 mm) o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.
- B. Provide not less than 1 inch (25 mm) of airspace between back of masonry veneer and face of insulation.
  - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### 3.7 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (152 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.

- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints in brick as follows:
  - 1. Build in compressible joint fillers where indicated.
- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch (10 mm).
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where indicated and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

### 3.10 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (203 mm); with upper edge tucked under water-resistive barrier, lapping at least 4 inches (102 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.
  - 3. At lintels and shelf angles, extend flashing 6 inches (152 mm) minimum at each end. At heads and sills, extend flashing 6 inches (152 mm) minimum and turn ends up not less than 2 inches (51 mm) to form end dams.
  - 4. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
  - 5. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
  - 1. Use specified weep/cavity vent products to form weep holes.
  - 2. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.
- E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.



### 3.11 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches (1524 mm).

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections on structural masonry. All other testing will be by Contractor. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- I. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 7 days and at 28 days.

### 3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

**END OF SECTION**

## SECTION 05 12 00

### STRUCTURAL STEEL FRAMING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural steel.
  - 2. Grout.
- B. Related Sections:
  - 1. Division 01 Sections for independent testing agency procedures and administrative requirements.
  - 2. Section 05 31 00 "Steel Decking" for field installation of shear connectors through deck.
  - 3. Section 05 50 00 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
  - 4. Section 05 51 00 "Metal Stairs."

##### 1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering design by a qualified professional engineer licensed in the state which the project is located, to withstand loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using schematic details indicated and AISC 360
  - 2. Use LRFD; data are given at factored-load level.
  - 3. For beams where no factored shear reaction is indicated, design connections to sustain one half the maximum uniform load for span length indicated in AISC 360, Table 3-6.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: As indicated.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Include embedment drawings.
  - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
  - 5. For structural-steel connections indicated to comply with design loads, include structural design data signed and sealed by the qualified professional engineer, licensed in the state in which the project is located, responsible for their preparation.
    - a. Calculations must be submitted with the shop drawings for review.
    - b. Indicate all applicable piece marks on calculations sheets.
    - c. Design simple shear connections for maximum factored reaction indicated. If no reaction has been indicated, design simple shear connections to withstand one-half the maximum uniform load for the given beam span noted in the AISC Steel Construction Manual Table.
    - d. Design moment connections for factored reactions indicated. If no reaction is provided, design the moment connection for the maximum available moment capacity of the smaller beam member framing into the joint.

- e. Design axial loaded members of trusses and bracing for the factored reactions indicated. If no reaction is indicated, design the member for the maximum tension and compression forces available to the member based on size and length. All bolted connection design shall account for net area reduction of the members.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand critical welds.
- D. Qualification Data: For qualified Installer, fabricator, professional engineer, and testing agency.
  - 1. Qualification Data must be submitted to Engineer prior to commencing work.
- E. Welding certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- G. Mill test reports for structural steel, including chemical and physical properties.
- H. Product Test Reports: For the following:
  - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - 2. Direct-tension indicators.
  - 3. Tension-control, high-strength bolt-nut-washer assemblies.
  - 4. Shear stud connectors.
  - 5. Shop primers.
  - 6. Nonshrink grout.
- I. Source quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
  - 1. As an exception, non-AISC certified fabricators will be accepted provided the fabricator includes in their bid the services of the owner's special inspection and testing agency to provide inspection/testing services for in-shop work to meet the requirements of IBC Section 1704 and any additional requirements noted in the construction documents. Final costs of these services will be as required by the owner's special inspection and testing agency, which may or may not be hired at the time of bidding the project. It will be the fabricator's responsibility for estimating these costs. Cost will be withheld from the fabricator to pay for these services. Refer to IBC Section 1705 for verification and inspection requirements.
  - 2. All inspection costs incurred by the Owner's inspection and testing agency for this exception will be tracked and invoiced to the owner independently of other special inspection costs to allow withholding from the relevant contractor's regular payments.
- B. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design and extent to that indicated for this Project and with a record of continuous successful in-service performance for a minimum of 5 years. Installer shall provide a list of projects completed within the last 5 years and shall include the names of the Architect, Engineer and General Contractor with contact information for each.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
  - 2. AISC 341 and AISC 341s1.
  - 3. AISC 360.
  - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
- C. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
- D. Clean and relubricate bolts and nuts that become dry or rusty before use.
- E. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.7 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

**PART 2 - PRODUCTS**

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M, unless otherwise indicated on Drawings.
- D. Plate and Bar for Plate Girders: ASTM A 992 (Grade 50). ASTM A 572, Grade 50 is an acceptable substitute.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  - 1. Weight Class: Standard, unless otherwise indicated.
  - 2. Finish: Black except where indicated to be galvanized.
- G. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
- H. Steel Forgings: ASTM A 668/A 668M.
- I. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
  - 1. Finish: Plain.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
  - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
  - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

4. Finish: Plain.
  - E. Threaded Rods: ASTM A 36/A 36M.
    1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
    2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
    3. Finish: Plain, unless otherwise indicated.
  - F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
  - G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
  - H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- 2.3 PRIMER
- A. Primer: Fabricator's standard gray color, lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
  - B. Galvanizing Repair Paint: ASTM A 780.
- 2.4 GROUT
- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- 2.5 FABRICATION
- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
    1. Camber structural-steel members where indicated.
    2. Fabricate beams with rolling camber up.
    3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
    4. Mark and match-mark materials for field assembly.
    5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
  - B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
    1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
  - C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
  - D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
  - E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning" and at architecturally exposed steel SSPC SP 3, "Power Tool Cleaning."
  - F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
  - G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
    1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
    2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
    3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- 2.6 SHOP CONNECTIONS
- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
    1. Joint Type: Snug tightened, unless otherwise indicated.
  - B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
    1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
  - 2. Surfaces to be field welded.
  - 3. Surfaces to be high-strength bolted with slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  - 1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
  - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls. Galvanize all structural steel not located in conditioned space in the final construction.

## 2.9 SOURCE QUALITY CONTROL

- A. This article is not applicable if fabricator is an "approved fabricator" by the Jurisdiction Having Authority in accordance with the building code. All shop testing and inspections costs incurred by the Owner's inspection and testing agency will be made payable by the fabricator. See Drawing Sheet S0.1 for further information and requirements. Submit approval certification to Architect/Engineer prior to commencing work.
- B. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
  - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  - 1. Liquid Penetrant Inspection: ASTM E 165.
  - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  - 3. Ultrasonic Inspection: ASTM E 164.
    - a. Test all Complete Joint Penetration (CJP) welds.
  - 4. Radiographic Inspection: ASTM E 94.
- F. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
  - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

#### **3.3 ERECTION**

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  - 1. Level and plumb individual members of structure.
  - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

#### **3.4 FIELD CONNECTIONS**

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug-tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.



3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
  1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
      - 1) Test all Complete Joint Penetration (CJP) welds.
    - d. Radiographic Inspection: ASTM E 94.
  2. Ultrasonic Inspection shall be performed on all complete joint penetration welds and other welds indicated.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 05 12 00

**SECTION 05 21 00**  
**STEEL JOIST FRAMING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. K-series steel joists.
  - 2. LH- and DLH-series long-span steel joists.
  - 3. Joist accessories.
- B. Related Requirements:
  - 1. Section 03 30 00 "Cast-in-Place Concrete" for installing bearing plates in concrete.
  - 2. Section 05 12 00 "Structural Steel Framing" for field-welded shear connectors.

1.2 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
  - 1. Include layout, designation, number, type, location, and spacing of joists.
  - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
  - 3. Indicate locations and details of bearing plates to be embedded in other construction.
  - 4. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer licensed in the state which the project is located, responsible for its preparation, and included with the shop drawing submittal. Shop drawings without signed and sealed calculations will be considered incomplete and grounds for rejection.
- C. Qualification Data: For manufacturer and professional engineer.
- D. Welding certificates.
- E. Manufacturer certificates: Signed by manufacturer certifying that joist comply with requirements.
- F. Mill Certificates: Signed by bolt manufacturer certifying that bolts comply with requirements.
- G. Field quality-control test and inspection reports.
- H. Research/Evaluation Reports: For joists.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
  - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.
- C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.6 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Design special joists to withstand design loads with live-load deflections no greater than the following:
  - 1. Roof Joists: Vertical deflection of 1/360 of the span.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
  - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- D. Provide holes in chord members for connecting and securing other construction to joists.
- E. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- F. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- G. Camber joists according to SJI's "Specifications."
- H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Camber long-span steel joists according to SJI's "Specifications."
- E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- B. Primer: Provide shop primer that complies with Division 09 painting Sections.

2.5 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- C. Steel bearing plates with integral anchorages are specified in Section 05 12 00 "Structural Steel Framing."

- D. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- E. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
  - 1. Finish: Plain, uncoated, unless otherwise noted.
- F. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain, unless otherwise indicated.
- G. Welding Electrodes: Comply with AWS standards.
- H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## 2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- D. Shop priming of joists and joist accessories is specified in Division 09 Painting Sections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
  - 1. Before installation, splice joists delivered to Project site in more than one piece.
  - 2. Space, adjust, and align joists accurately in location before permanently fastening.
  - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
  - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

- B. Visually inspect field welds according to AWS D1.1/D1.1M.
    - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
      - a. Liquid Penetrant Inspection: ASTM E 165.
      - b. Magnetic Particle Inspection: ASTM E 709.
      - c. Ultrasonic Testing: ASTM E 164.
      - d. Radiographic Testing: ASTM E 94.
  - C. Visually inspect bolted connections.
  - D. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."
  - E. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
  - F. Perform additional testing to determine compliance of corrected Work with specified requirements.
- 3.4 PROTECTION
- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
    - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
    - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
  - B. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.
  - C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

## SECTION 05 31 00

### STEEL DECKING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Roof deck.
  - 2. Composite floor deck.
- B. Related Sections include the following:
  - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete fill on metal decks.
  - 2. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
  - 3. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

##### 1.2 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
  - 1. Power-actuated mechanical fasteners.
- G. Research/Evaluation Reports: For steel deck.

##### 1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- D. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or pre-approved equal:
  - 1. Steel Deck:
    - a. ASC Profiles, Inc.
    - b. Canam Steel Corp.;The Canam Manac Group.
    - c. Consolidated Systems, Inc.
    - d. DACS, Inc.

- e. D-Mac Industries Inc.
- f. Epic Metals Corporation.
- g. Marlyn Steel Decks, Inc.
- h. Metal Dek Group; Unit of Csi.
- i. New Millennium Building Systems, LLC.
- j. Nucor Corp.; Vulcraft Division.
- k. Roof Deck, Inc.
- l. United Steel Deck, Inc.
- m. Valley Joist; Division of EBSCO Industries, Inc.
- n. Verco Manufacturing Co.
- o. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

## 2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
  - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 50 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
    - a. Color: Manufacturer's standard gray.
  - 2. Deck Profile: As indicated.
  - 3. Profile Depth: As indicated.
  - 4. Design Uncoated-Steel Thickness: As indicated.
  - 5. Span Condition: Triple or more span.
  - 6. Side Laps: Overlapped.

## 2.3 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
  - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50, G60 zinc coating.
  - 2. Profile Depth: As indicated.
  - 3. Design Uncoated-Steel Thickness: As indicated.
  - 4. Span Condition: Triple or more span.

## 2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

#### **3.2 INSTALLATION, GENERAL**

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck, except at perimeter edges of deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions. Mechanical fasteners must meet the same pull out and shear values as welds. Engineering calculations must be provided for Engineer's review.

#### **3.3 ROOF-DECK INSTALLATION**

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
  - 1. Weld Diameter: 5/8 inch nominal, unless otherwise noted on Drawings.
  - 2. Weld Spacing: Space welds As Indicated.
  - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
  - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
  - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

#### **3.4 FLOOR-DECK INSTALLATION**

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 5/8 inch nominal.
  - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.



- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch.
  - 3. Fasten with a minimum of 1-1/2-inch- long welds at deck perimeter edge.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints as follows:
  - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

## SECTION 05 40 00

### COLD-FORMED METAL FRAMING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Exterior non-load-bearing wall framing.
  - 2. Interior non-load-bearing wall framing.
  - 3. Soffit framing.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Meet with Owner, Architect, testing and inspecting agency representative, metal framing Installer, Metal Framing Engineer, exterior sheathing Installer, and installers whose work interfaces with or affects cold-formed metal framing.
- C. Review methods and procedures related to cold-formed metal framing installation, including those contained in metal framing engineer's delegated design submittal.
- D. Review design loads imposed on building structure.
  - 1. Review and clearly identify locations of interior and corner wind load zones of building façade.
  - 2. Review design wind speeds and resulting positive and negative loads imposed on metal framing and exterior sheathing at interior zones and corner zones of building façade.
  - 3. Review securement of system components required to withstand design wind loads, including the following:
    - a. Attachment of bottom track to floor structure, and type and spacing of fasteners.
    - b. Attachment of top track to overhead structure, and type and spacing of fasteners.
    - c. Attachment of studs to top and bottom tracks.
    - d. Attachment of clips to overhead structure.
    - e. Attachment of studs to clips.
    - f. Review required minimum edge clearance from edge of slab, and size, spacing, and required penetration of fasteners.
- E. Review size and location of exterior wall framing mockup.
- F. Review requirements and understanding of Field Quality Control article.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following: For each type of product specified.
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
  - 3. Indicate exterior sheathing screw fastener spacing to be utilized at interior zones and corner zones of building façade, as required to ensure sheathing installation will withstand negative wind pressures imposed by design wind speeds.
- C. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.

- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
    - 1. Steel sheet.
    - 2. Expansion anchors.
    - 3. Power-actuated anchors.
    - 4. Mechanical fasteners.
    - 5. Vertical deflection clips.
    - 6. Horizontal drift deflection clips
    - 7. Miscellaneous structural clips and accessories.
  - E. Research Reports:
    - 1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
    - 2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
  - B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or be a part of a similar organization that provides verifiable code compliance program.
  - C. Welding Qualifications: Qualify procedures and personnel according to the following:
    - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
    - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
  - D. Field Quality Control:
    - 1. Photographic documentation of approved exterior wall framing mockup, in digital form. Include pan and close-up photos of the following:
      - a. Attachment of bottom track to floor structure.
      - b. Attachment of top track to overhead structure.
      - c. Attachment of studs to bottom track and top track/clips.
      - d. Attachment of vertical deflection clips to overhead structure.
      - e. Attachment of horizontal drift clips to overhead structure.
      - f. Attachment of studs to vertical deflection clips.
      - g. Attachment of studs to horizontal drift clips.
      - h. Attachment of sheathing to studs.
    - 2. Pre-Inspection Notification: Submit written report that work has been reviewed for compliance by Contractor, Installer, and Metal Framing Engineer, and is ready for inspection by Testing Agency.
  - E. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA) or be a part of a similar organization that provides verifiable code compliance program.
    - 1. Products to be certified under an independent third-party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.
  - F. Comply with AISI S100, and AISI S200 and ASTM C955, Section 8.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. CEMCO: [www.cemcosteel.com](http://www.cemcosteel.com).
  - 2. ClarkDietrich: [www.clarkdietrich.com/](http://www.clarkdietrich.com/)
  - 3. MarinoWare: [www.marinoware.com](http://www.marinoware.com)
  - 4. SCAFCO Corporation: [www.scafco.com](http://www.scafco.com).
  - 5. The Steel Network, Inc.: [www.SteelNetwork.com](http://www.SteelNetwork.com).

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing including fasteners and connections to building structure.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    - a. Exterior Non-Load-Bearing Framing behind Brick or Stone Masonry Veneer: Horizontal deflection of 1/600 of the wall height.
    - b. Exterior Non-Load-Bearing Framing behind Metal Panels: Horizontal deflection of 1/240 of the wall height.
    - c. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
  - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
  - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    - a. Upward and downward movement of 1 inch (25 mm) unless otherwise indicated on structural drawings.
  - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100, S200, S211, and ASTM C955, Section 8.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

## 2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Framing Members, General: Comply with AISI S200 and ASTM C955, Section 8 for conditions indicated.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90).
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60 (Z180).

## 2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: As required by structural performance..
  - 2. Flange Width: As required by structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: As required by structural performance..
  - 2. Flange Width: As required by structural performance.

- C. Vertical Deflection Clips, Exterior: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. Steel Network, Inc. (The).
- D. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure, as follows:
  - 1. Leg Dimension: 2-1/2 inches (63.5 mm) with 1-1/2-inch (38.1-mm) slot.
  - 2. Minimum Thickness: Match stud thickness.
  - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. Steel Network, Inc. (The).
  - 4. Basis of Design Product: ClarkDietrich; BlazeFrame DSL Slotted Deflection Track.

## 2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: As required by structural performance. .
  - 2. Flange Width: As required by structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: As required by structural performance.
  - 2. Flange Width: As required by structural performance.
- C. Slotted Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure, as follows:
  - 1. Leg Dimension: 2-1/2 inches (63.5 mm) with 1-1/2-inch (38.1-mm) slot.
  - 2. Minimum Thickness: Match stud thickness.
  - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. Steel Network, Inc. (The).
  - 4. Basis of Design Product: ClarkDietrich; BlazeFrame DSL Slotted Deflection Track.
- D. Vertical Deflection Clips, Interior: Manufacturer's standard headclips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. Steel Network, Inc. (The).
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: As required by structural performance.
  - 2. Flange Width: As required by structural performance.

## 2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  - 1. Supplementary framing.
  - 2. Bracing, bridging, and solid blocking.
  - 3. Web stiffeners.
  - 4. Anchor clips.
  - 5. End clips.
  - 6. Foundation clips.
  - 7. Gusset plates.
  - 8. Stud kickers and knee braces.
  - 9. Joist hangers and end closures.
  - 10. Hole-reinforcing plates.
  - 11. Backer plates.

## 2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 55, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B695, Class 50.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure.
  - 2. Type: Torque-controlled expansion anchor.
  - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

## 2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

## 2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
  - 1. Fabricate framing assemblies using jigs or templates.
  - 2. Cut framing members by sawing or shearing; do not torch cut.
  - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
  - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
  - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
  - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
  - 1. Cut framing members by sawing or shearing; do not torch cut.
  - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

### 3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Connect vertical deflection clips to infill studs and anchor to building structure.
  - 2. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.5 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Connect vertical deflection clips to studs and anchor to building structure.
  - 2. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
  - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.



3.6 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

**SECTION 05 50 00**  
**METAL FABRICATIONS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Steel framing and supports for overhead doors.
  - 2. Steel framing and supports for countertops.
  - 3. Steel tube reinforcement for low partitions.
  - 4. Steel framing and supports for mechanical and electrical equipment.
  - 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 6. Steel shapes for supporting elevator door sills.
  - 7. Miscellaneous framing and supports.
  - 8. Shelf angles.
  - 9. Metal ladders.
  - 10. Elevator pit sump covers.
  - 11. Miscellaneous steel trim.
  - 12. Metal bollards.
  - 13. Loose bearing and leveling plates.
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Loose steel lintels.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each product specified in PART 2.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for all fabrications indicated in PART 2.
- C. Include shop drawings and structural analysis data signed and sealed by the qualified professional engineer licensed to practice in the location of the project, demonstrating the design and connections will meet all indicated and code required loads for the following items:
  - 1. Each type of ladder.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- C. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: As indicated.
  - 2. Cold-Rolled Steel: ASTM A1008/A1008M, commercial steel, Type B; 0.0677-inch (1.7-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.
- F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 2 (A4).
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Post-Installed Anchors: Torque-controlled expansion anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Division 09 Section(s) on Painting
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

- C. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Weld steel angles to embedded structural members unless otherwise indicated.

- D. Galvanize and prime shelf angles located in exterior walls.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.8 METAL LADDERS

- A. General:
  - 1. Comply with ANSI A14.3, except for elevator pit ladders.
  - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
  - 1. Space siderails 16 inches (406 mm) apart unless otherwise indicated.
  - 2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
  - 3. Rungs: 3/4-inch- (19-mm-) diameter, steel bars.
  - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
  - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  - 6. Nonslip Surfaces for Steel Ladders: Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) IKG; MEBAC.
      - 2) Ohio Gratings, Inc.; ALGRIP Traction Surface.
      - 3) SlipNOT Metal Safety Flooring; W.S. Molnar Company; SlipNOT.
  - 7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
  - 8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
  - 9. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
  - 10. Galvanize and prime exterior ladders, including brackets.

## 2.9 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
- B. Provide steel angle supports unless otherwise indicated.

## 2.10 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer.

## 2.11 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe.
- B. Prime steel bollards with zinc-rich primer.

## 2.12 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

- B. Galvanize bearing and leveling plates.
- C. Prime plates with zinc-rich primer.

#### 2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.

#### 2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

#### 2.15 BRAKE METAL

- A. Material: Galvanized steel formed in press brake.
  - 1. Thickness: As indicated.
  - 2. Finish: Field Painted.
  - 3. Texture: Smooth.
  - 4. Profile: As indicated.

#### 2.16 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

#### 2.17 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer compatible with top, intermediate, and top coats indicated in Division 09 painting sections .
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

### **PART 3 - EXECUTION**

#### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
    - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - 2. Obtain fusion without undercut or overlap.
    - 3. Remove welding flux immediately.
    - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
  - D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
  - E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS
- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
  - B. Anchor shelf angles securely to existing construction with anchor bolts or welding where indicated.
- 3.3 INSTALLATION OF SHELF ANGLES
- A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.
- 3.4 INSTALLATION OF METAL LADDERS
- A. Secure ladders to adjacent construction with the clip angles attached to the stringer.
  - B. Install brackets as required for securing of ladders welded or bolted to structural steel or built into masonry or concrete.
- 3.5 INSTALLATION OF ELEVATOR PIT SUMP COVERS
- A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.
- 3.6 INSTALLATION OF MISCELLANEOUS STEEL TRIM
- A. Anchor to concrete construction to comply with manufacturer's written instructions.
- 3.7 INSTALLATION OF METAL BOLLARDS
- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  - B. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.
    - 1. Embed anchor bolts at least 4 inches (100 mm) in concrete.
  - C. For new construction, anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
  - D. Fill bollards solidly with concrete, mounding top surface to shed water.
- 3.8 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES
- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
  - B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.9 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
  - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 Painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

**END OF SECTION**



## SECTION 05 51 13

### METAL PAN STAIRS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Preassembled steel stairs with concrete-filled and precast terrazzo treads and risers.

##### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs.
  - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
  - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
  - 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For metal pan stairs and the following:
  - 1. Shop primer products.
  - 2. Precast terrazzo treads and risers.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
  - 3. Include plan at each level.
  - 4. Indicate profile and dimensions of precast terrazzo treads and risers.
- C. Delegated-Design Submittal: For stairs and precast terrazzo treads and risers, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
  - 1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
  - 2. Protect steel members and packaged materials from corrosion and deterioration.
  - 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
    - a. Repair or replace damaged materials or structures as directed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs and precast terrazzo treads and risers, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
  - 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

### 2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

### 2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
  - 1. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
  - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.
- E. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

### 2.4 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.

- B. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

## 2.5 PRECAST TERRAZZO TREADS AND RISERS

- A. Precast Terrazzo Stair Treads and Risers: Epoxy terrazzo units cast in maximum lengths possible. Comply with manufacturer's written instructions for fabricating precast terrazzo units in sizes and profiles indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Concord Terrazzo Company.
    - b. Terrazzo & Marble Supply Companies.
    - c. Wausau Tile Inc.
  - 2. Basis-of-Design Product: As scheduled.
  - 3. Epoxy Resin Matrix: Manufacturer's standard recommended for use indicated.
  - 4. Aggregates: Comply with NTMA gradation standards for mix indicated, and containing no deleterious or foreign matter.
    - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
    - b. 24-Hour Absorption Rate: Less than 0.75 percent.
    - c. Dust Content: Less than 1.0 percent by weight.
  - 5. Reinforcement: ASTM A615/A615M, Grade 60 (Grade 420) bars, as required by unit size, profile, and thickness.
  - 6. Abrasive Inserts: 1/2-inch- (13-mm-) wide, silicon carbon/epoxy mixture.
    - a. Provide three inserts, 1/2 inch (13 mm) apart, with first insert located 1 inch (25 mm) from nosing at adjacent stair riser locations.
  - 7. Color: As selected by Architect from manufacturer's standard color selections.
  - 8. Finish: Honed.
  - 9. Surface Sealer: Slip- and stain-resistant, penetrating sealer that is chemically neutral with pH factor between 7 and 8; does not affect color or physical properties of terrazzo type indicated; is recommend by sealer manufacturer for use with specified terrazzo; and complies with NTMA guide specification for terrazzo type applicable for this Project.

## 2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
  - 1. Disassemble units only as necessary for shipping and handling limitations.
  - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
  - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
  - 2. Locate joints where least conspicuous.

3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

## 2.7 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural exposed applications in common areas and Commercial for fire stairs Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  1. Fabricate stringers of steel plates or steel channels.
    - a. Stringer Size: As required to comply with "Performance Requirements" Article.
    - b. Provide closures for exposed ends of channel and rectangular tube stringers.
    - c. Finish: Shop primed.
  2. Construct platforms of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
    - a. Provide closures for exposed ends of channel and rectangular tube framing.
    - b. Finish: Shop primed.
  3. Weld stringers to headers; weld framing members to stringers and headers.
  4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
    - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
  5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).
  1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
  2. Steel Sheet: Uncoated, cold -rolled steel sheet.
  3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
  4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  5. Shape metal pans to include nosing integral with riser.
  6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
    - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
  - B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
  - C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
    1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
      - a. Clean bottom surface of plates.
      - b. Set plates for structural members on wedges, shims, or setting nuts.
      - c. Tighten anchor bolts after supported members have been positioned and plumbed.
      - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
      - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
        - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
        - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
  - D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
  - E. Fit exposed connections accurately together to form hairline joints.
    1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
    2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
    3. Comply with requirements for welding in "Fabrication, General" Article.
  - F. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 "Cast-in-Place Concrete."
  - G. Install precast terrazzo treads and risers according to manufacturer's written instructions.
- 3.3 REPAIR
- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 23 "Interior Painting."
  - B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

**END OF SECTION**

## SECTION 05 52 13

### PIPE AND TUBE RAILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel railings.

##### 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Fasteners.
  - 3. Post-installed anchors.
  - 4. Handrail brackets.
  - 5. Shop primer.
  - 6. Intermediate coats and topcoats.
  - 7. Nonshrink, nonmetallic grout.
  - 8. Anchoring cement.
  - 9. Metal finishes.
  - 10. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- D. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

##### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

##### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.

### **2.2 METALS, GENERAL**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

### **2.3 STEEL RAILINGS**

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.
- E. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

### **2.4 FASTENERS**

- A. Fastener Materials:
  - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941 (ASTM F1941M), Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
  - 3. Finish exposed fasteners to match appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

## 2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast iron center of handrail 3-1/8 inches (79.4 mm) from face of railing.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop-assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
  - 1. Clearly mark units for reassembly and coordinated installation.
  - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
  - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
  - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
  - 1. Provide weep holes where water may accumulate.
  - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 and Finish #3 welds, as follows:
    - a. Finish #2 Welds: Good appearance, completely sanded joint, some undercutting and pinholes okay for exposed monumental stairs.
    - b. Finish #3 Welds: Utilitarian appearance not subject to view, partially dressed weld with spatter removed for typical enclosed exit stairs.
- I. Form changes in direction as follows:
  - 1. As detailed.
- J. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.



- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
  - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
  - 2. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
  - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
  - 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
  - 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
  - 4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
  - 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
  - 1. Comply with SSPC-SP 16.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
  - 1. Other Railings: SSPC-SP 3.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
  - 1. Shop prime uncoated railings with primers specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting".
  - 2. Do not apply primer to galvanized surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
  - 1. Fit exposed connections together to form tight, hairline joints.
  - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
  - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
  - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

### 3.4 ANCHORING POSTS

- A. Cover anchorage joint with flange of same metal as post, attached to post with setscrews.
- B. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

### 3.5 ATTACHING RAILINGS

- A. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.6 REPAIR

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

### 3.7 CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

### 3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**

## SECTION 05 58 13

### COLUMN COVERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes snap-together metal column covers.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for column covers.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

##### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing column covers similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings of type indicated to metals of types indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups of typical column covers.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

#### PART 2 - PRODUCTS

##### 2.1 SNAP-TOGETHER COLUMN COVERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ATAS International, Inc.
  - 2. Construction Services, Inc.
  - 3. Firestone Metal Products, LLC.
  - 4. Fry Reglet Corporation.
  - 5. Leed Himmel Industries, Inc.
  - 6. MM Systems Corporation.
  - 7. PAC-CLAD Petersen; a Carlisle company.
  - 8. Pittcon Industries.
- B. Basis-of-Design Product: PAC-CLAD Petersen; a Carlisle company; PAC-1000F, Flush Joint Column Cover.

- C. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.
  - 1. Aluminum Sheet: ASTM B 209 (ASTM B 209M), with not less than strength and durability properties of Alloy 5005-H32, 0.090 inch thick.
    - a. Finish: High-performance organic coating.
  - 2. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
  - 3. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
  - 4. Form returns at vertical joints to accommodate backer rod and sealant.
  - 5. Assemble columns sections using a rivnut/keyhole system to provide a tight, inconspicuous vertical seam.
  - 6. Fabricate column covers without horizontal joints.
  - 7. Fabricate base ring to match column covers.
  - 8. Fabricate with calk stop/stiffener ring.
  - 9. Apply manufacturer's recommended sound-deadening insulation to backs of column covers.

## 2.2 MISCELLANEOUS MATERIALS

- A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
  - 1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless otherwise indicated.
  - 2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- B. Sound-Deadening Materials:
  - 1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
  - 2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Backing Materials: Provided or recommended by column cover manufacturer.

## 2.3 PAINTS AND COATINGS

- A. Shop Primers: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.4 FABRICATION, GENERAL

- A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.
- B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.
  - 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Use concealed anchorages where possible.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.
- E. Apply joint treatment at joints of spackled-seam metal column covers. Comply with requirements in Section 09 29 00 "Gypsum Board."

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

- A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

**END OF SECTION**

## SECTION 05 73 01

### DECORATIVE METAL RAILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel and iron decorative railings.

##### 1.2 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

##### 1.3 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of railings assembled from standard components.
  - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

##### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- D. Preconstruction test reports.
- E. Evaluation Reports: For post-installed anchors, from ICC-ES.

##### 1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Steel and Iron Decorative Railings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Architectural Iron Designs, Inc.
    - b. Blum, Julius & Co., Inc.
    - c. Braun, J. G., Company; The Wagner Companies.
    - d. Lawler Foundry Corporation.
    - e. Livers Bronze Co.
    - f. VIVA Railings, LLC.
    - g. Wagner, R & B, Inc.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. See Section 01 60 00 "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.

### 2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
  - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
  - 2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
  - 3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
  - 4. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.

### 2.4 STEEL AND IRON

- A. Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

## 2.5 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
  - 2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
  - 1. Provide Phillips- flat-head machine screws for exposed fasteners unless otherwise indicated.
- C. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

## 2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

## 2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.



- I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
  - 1. As detailed.
- K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of hollow railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.9 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, but galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
- D. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.
- E. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:
  - 1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
  - 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
  - 4. Color: As selected by Architect from manufacturer's full range to match door hardware.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

#### **3.2 INSTALLATION, GENERAL**

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

#### **3.3 RAILING CONNECTIONS**

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

#### **3.4 ANCHORING POSTS**

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- C. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.

#### **3.5 CLEANING**

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 23 "Interior Painting."

#### **3.6 PROTECTION**

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**

## SECTION 05 73 13

### GLAZED DECORATIVE METAL RAILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass-supported railings.

##### 1.2 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

##### 1.3 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of railings assembled from standard components.
  - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required.
  - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Each type of glass required.
  - 3. Fittings and brackets.
  - 4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- E. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

##### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- C. Evaluation Reports: For post-installed anchors, from ICC-ES.

##### 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups as shown on Drawings.

2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Architectural Railings & Grilles, Inc.
  2. Julius Blum & Co., Inc.
  3. C. R. Laurence Co., Inc.
  4. Livers Bronze Co.
  5. P & P Artec.
  6. VIVA Railings.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.
  1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
  2. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

#### 2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

#### 2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
- B. Extruded Bars and Shapes, Including Extruded Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 5005-H32.
- F. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

#### 2.5 GLASS AND GLAZING MATERIALS

- A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
- B. Laminated Glass: ASTM C 1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than 0.060 inch (1.52 mm) thick.
  - 1. Kind: LT (laminated tempered).
  - 2. Glass Color: Clear.
  - 3. Interlayer Color: Clear.
  - 4. Glass Plies for Structural Glass Balusters: Thickness required by structural loads, but not less than 6.0 mm thick each.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.
  - 1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.

#### 2.6 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Aluminum Components: Type 304 stainless-steel fasteners.
  - 2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated exposed fasteners are unavoidable.
  - 1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

#### 2.7 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.8 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- H. Form changes in direction as follows:
  - 1. By bending.
- I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of hollow railing members with prefabricated end fittings.
- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.9 GLAZING PANEL FABRICATION

- A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.
  - 1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
  - 2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.
- B. Structural Glass Balusters: Factory-bond glass to aluminum base and top-rail channels in railing manufacturer's plant using glazing cement to comply with manufacturer's written specifications, unless field glazing is standard with manufacturer.
- C. Structural Balusters: Provide laminated, tempered glass panels.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.11 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range to match door hardware.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.2 ANCHORING POSTS

- A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.

### 3.3 INSTALLING GLASS PANELS

- A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
  - 1. Attach base channel to building structure, then insert and connect factory-fabricated and -assembled glass panels if glass was bonded to base and top-rail channels in factory.
  - 2. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement unless glass was bonded to base and top-rail channels in factory.
    - a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.
  - 3. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
  - 4. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment.
- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.
- D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING

- A. Clean aluminum by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

3.6 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**



## SECTION 06 10 53

### MISCELLANEOUS ROUGH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  1. Rooftop equipment bases and support curbs.
  2. Wood blocking and nailers.
  3. Wood furring.
  4. Plywood backing panels.

##### 1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
  4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
  1. Preservative-treated wood.
  2. Fire-retardant-treated wood.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

#### PART 2 - PRODUCTS

##### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  1. Factory-mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
  3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
  - 5. Wood floor plates that are installed over concrete slabs-on-grade.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Treatment shall not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
  - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
  - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat all miscellaneous carpentry unless otherwise indicated.

## 2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
  - 4. Furring.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
  - 1. Mixed southern pine or southern pine; SPIB.
  - 2. Spruce-pine-fir; NLGA.
  - 3. Western woods; WCLIB or WWPA.

4. Northern species; NLGA.
  5. Eastern softwoods; NeLMA.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.
- 2.5 PLYWOOD BACKING PANELS
- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.
- 2.6 FASTENERS
- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: ASTM C1002 or ASTM C954, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.
1. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).
- 2.7 MISCELLANEOUS MATERIALS
- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

### **PART 3 - EXECUTION**

- 3.1 INSTALLATION, GENERAL
- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

- G. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

### 3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

### 3.3 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches (610 mm) o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

### 3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION**

## SECTION 06 16 36

### WOOD PANEL PRODUCT SHEATHING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Subflooring.
  - 2. Underlayment.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and product.
  - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
  - 2. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
  - 3. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Fire-retardant-treated plywood.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

##### 2.2 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

##### 2.3 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
  3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
  - D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
  - E. Application: Treat all plywood unless otherwise indicated.
- 2.4 SUBFLOORING AND UNDERLAYMENT
- A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged single-floor panels.
    1. Span Rating: Not less than 16.
    2. Nominal Thickness: Not less than 23/32 inch (18.3 mm).
    3. Edge Detail: Square.
    4. Surface Finish: Fully sanded face.
- 2.5 FASTENERS
- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
    1. Provide fasteners of Type 304 stainless steel.
  - B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
  - C. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  2. ICC-ES evaluation report for fastener.
- D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

#### **3.2 WOOD STRUCTURAL PANEL INSTALLATION**

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Combination Subfloor-Underlayment:
    - a. Screw to cold-formed metal framing.
    - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

**END OF SECTION**

## SECTION 06 16 43

### GYPSUM SHEATHING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Wall sheathing.
  - 2. Parapet sheathing.
  - 3. Sheathing joint and penetration treatment.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

##### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

#### PART 2 - PRODUCTS

##### 2.1 WALL AND PARAPET SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corporation; GlasRoc.
    - b. Continental Building Products, LLC; Weather Defense.
    - c. Georgia-Pacific Building Products; Dens-Glass Sheathing.
    - d. National Gypsum Company; Gold Bond eXP Sheathing.
    - e. United States Gypsum Company; Securock.
  - 2. Type and Thickness: Regular, 1/2 inch (12.7 mm) thick unless Type X is required by building code or indicated on drawings.
  - 3. Size: 48 by 120 inches (1219 by 3048 mm) for vertical installation.
  - 4. Mold Growth: 10 when tested according to ASTM D3273.
  - 5. Permeance: 22 perms.
  - 6. Combustibility: Noncombustible.
  - 7. Coating: If required by roofing system manufacturer for adhering membrane to sheathing, provide factory applied coating to sheathing to enhance adhesion.

##### 2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
  - 1. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.



### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. ICC-ES evaluation report for fastener.
- D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

#### **3.2 GYPSUM SHEATHING INSTALLATION**

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
  - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

**END OF SECTION**

## SECTION 06 41 16

### PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Plastic-laminate-clad architectural cabinets.
  - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

##### 1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show large-scale details.
  - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
  - 5. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Verification: For the following:
  - 1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.
    - a. Provide one sample applied to core material with specified edge material applied to one edge.
  - 2. Thermoset Decorative Panels: 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
    - a. Provide edge banding on one edge.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of product.
  - 1. Composite wood products.
  - 2. Thermoset decorative panels.
  - 3. High-pressure decorative laminate.
  - 4. Adhesives.
- C. Field quality-control reports.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

##### 1.7 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**PART 2 - PRODUCTS**

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
  - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Abet Laminati Inc.
    - b. Formica Corporation.
    - c. Lamin-Art, Inc.
    - d. Pionite; a Panolam Industries International, Inc. brand.
    - e. Wilsonart.
- F. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade VGS.
  - 4. Edges: Grade HGS.
  - 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Materials for Semiexposed Surfaces:
  - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
    - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
    - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
    - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
  - 2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
  - 3. Drawer Bottoms: Thermoset decorative panels.
- H. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As scheduled.

## 2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  - 2. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- B. Back-Mounted Pulls: BHMA A156.9, B02011.
- C. Wire Pulls: Back mounted, solid metal, 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- E. Shelf Rests: BHMA A156.9, B04013; metal.
- F. Drawer Slides: BHMA A156.9.
  - 1. Grade 1 and Grade 2: Side mounted.
    - a. Type: Full extension.
    - b. Material: Epoxy-coated steel with polymer rollers.
  - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full -extension type; zinc-plated-steel ball-bearing slides.
  - 3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 2.
  - 4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
  - 5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100.
  - 6. For computer keyboard shelves, provide Grade 1.
  - 7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Door and Drawer Silencers: BHMA A156.16, L03011.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Stainless Steel: BHMA 630 unless noted otherwise.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

#### 2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

### **PART 3 - EXECUTION**

#### 3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

#### 3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
  - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
  - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c..

#### 3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
  - 1. Inspection entity shall prepare and submit report of inspection.

#### 3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

**END OF SECTION**

## SECTION 06 46 00

### WOOD TRIM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior standing and running trim.
  - 2. Wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
  - 3. Shop finishing of wood trim.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including fire-retardant-treated materials and finishing materials and processes.
  - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
- C. Samples for Initial Selection:
  - 1. Shop-applied transparent finishes.
- D. Samples for Verification:
  - 1. Lumber for transparent finish, not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

##### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups of typical wood trim as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver wood trim until operations that could damage wood trim have been completed in installation areas. If wood trim must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood trim can be supported and installed as indicated.

**PART 2 - PRODUCTS**

2.1 WOOD TRIM, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood trim indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
  - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Custom.
- B. Wood Species and Cut: As scheduled.
  - 1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
- C. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.
  - 1. For veneered base, use hardwood lumber core, glued for width.
- D. For base wider than available lumber, glue for width. Do not use veneered construction.
- E. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.
  - 1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (75 mm) wide.
  - 2. Wood Moisture Content for Interior Materials: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified unless otherwise indicated.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
  - 1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
  - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

- B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. For exterior applications, use materials that comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
  - 2. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
  - 3. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
  - 4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

## 2.5 MISCELLANEOUS MATERIALS

- A. Interior Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

## 2.6 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate wood trim to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
  - 2. Edges of Similar Members More Than 3/4 inch (19 mm) Thick: 1/8 inch (3 mm).
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members except for members with ends exposed in finished work.
- D. Assemble casings in shop except where shipping limitations require field assembly.
- E. Assemble moldings in shop to maximum extent possible. Miter corners in shop and prepare for field assembly with bolted fittings designed to pull connections together.

## 2.7 SHOP FINISHING

- A. General: Finish wood trim at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to end-grain surfaces.
- C. Transparent Finish for Interior Trim:
  - 1. Grade: Same as item to be finished.
  - 2. Finish: System - 11, catalyzed polyurethane.
  - 3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
  - 4. Staining: Match Architect's sample.
  - 5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
  - 6. Sheen: As selected by Architect, in gloss units measured on 60-degree gloss meter per ASTM D 523.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition wood trim to average prevailing humidity conditions in installation areas.



- B. Before installing architectural wood trim, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install wood trim to comply with same grade as item to be installed.
- B. Assemble wood trim and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWPA M4.
- G. Anchor wood trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
  - 1. For shop-finished items, use filler matching finish of items being installed.
- H. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
  - 1. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.
  - 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- I. Touch up finishing work specified in this Section after installation of wood trim. Fill nail holes with matching filler where exposed.
  - 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective wood trim, where possible, to eliminate functional and visual defects; where not possible to repair, replace wood trim. Adjust joinery for uniform appearance.
- B. Clean wood trim on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

**END OF SECTION**

## SECTION 06 64 00

### PLASTIC PANELING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Plastic sheet paneling.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling, in manufacturer's standard sizes.

##### 1.3 QUALITY ASSURANCE

- A. Testing Agency: Acceptable to authorities having jurisdiction.

##### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

##### 2.2 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319. Panels shall be USDA accepted for incidental food contact.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Composites, Inc.
    - b. Marlite.
    - c. Nudo Products, Inc.
  - 2. Basis-of-Design Product: As scheduled.
  - 3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 4. Nominal Thickness: Not less than 0.09 inch (2.3 mm).
  - 5. Surface Finish: As selected by Architect from manufacturer's full range.
  - 6. Color: As scheduled.

##### 2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  - 1. Color: Match panels.
- B. Adhesive: As recommended by plastic paneling manufacturer.
- C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
  - 1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
  - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

#### **3.3 INSTALLATION**

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

**END OF SECTION**

## SECTION 07 14 00

### ELEVATOR PIT WATERPROOFING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following applications for use at elevator pits:
  - 1. HDPE sheet waterproofing below elevator pit slab-on-grade.
  - 2. Cold fluid applied waterproofing at elevator pit walls.
  - 3. Molded-sheet drainage panels.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
  - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, waterstops and other termination conditions.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- B. Submit evidence that Installer's existing company has minimum of 5 years continuous experience in application of specified materials. Submit list of at least five completed projects of similar scope and size, including:
  - 1. Project name.
  - 2. Owner's name.
  - 3. Owner's Representative name, address, and telephone number.
  - 4. Description of work.
  - 5. Self-adhering sheet materials used.
  - 6. Project supervisor.
  - 7. Total cost of waterproofing work and total cost of project.
  - 8. Completion date
- C. Sample Warranties: Copies of waterproofing manufacturer's warranty, Installer's warranty, and General Contractor's warranty, all stating obligations, remedies, limitations, and exclusions. Submitted with Bid.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials and molded-sheet drainage panels through one source from a single manufacturer.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
- B. Do not apply waterproofing in snow, rain, fog, or mist.
- C. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
  - 1. Warranty Period: 5 years from date of Substantial Completion.
- B. Installer's Warranty:
  - 1. Written warranty signed by Installer and Contractor, including
    - a. Repair or replace waterproofing or sheet flashings that do not comply with requirements; that do not remain watertight; that fail in adhesion, cohesion, or general durability; or that deteriorate in manner not clearly specified by submitted waterproofing manufacturer's data as inherent quality of material for application indicated.
    - b. Removal and reinstallation of protection board and drainage panels Warranty includes replacing materials as necessary.
    - c. Repair or replacement, to satisfaction of Owner, of other work or items which may have been displaced or damaged as consequence of defective work.
    - d. Make immediate emergency repairs within 48 hours of notice of leakage.
    - e. Warranty does not include removal or reinstallation of plantings, soil overburden, or backfill in planters; or concrete or asphalt toppings.
    - f. Warranty Period: 5 years after Substantial Completion date.
- C. Contractor Warranty:
  - 1. Written warranty signed by Contractor, including
    - a. Removal and reinstallation of plantings, soil overburden, and backfill in planters; and concrete and asphalt toppings. Provide new materials to replace materials that are not suitable for reuse, in opinion of Architect.
    - b. Repair or replacement, to satisfaction of Owner, other work or items which may have been displaced or damaged as consequence of defective work.
    - c. Make immediate emergency repairs within 48 hours of notice of leakage.
    - d. Warranty Period: 5 years after Substantial Completion date.

**PART 2 - PRODUCTS**

2.1 ELEVATOR PIT SHEET WATERPROOFING

- A. Location: Positive side, horizontal slab application.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. GCP Applied Technologies Inc.; Preprufe 300R Plus.
  - 2. Polyguard Products, Inc.; Underseal Underslab Membrane.
  - 3. W.R. Meadows, Inc.; PRECON.
- C. HDPE Sheet Waterproofing:
  - 1. Physical Properties: As follows, measured per standard test methods referenced:
    - a. Tensile Strength, Film: 4000 psi minimum; ASTM D 412.
    - b. Low-Temperature Flexibility: Pass at minus 10 deg F; ASTM D 1970.
    - c. Peel Adhesion to Concrete: 5 lbf/in.; ASTM D 903, modified.
    - d. Lap Adhesion: 2.5 lbf/in.; ASTM D 1876, modified.
    - e. Hydrostatic-Head Resistance: 231 ft.; ASTM D 5385, modified.
    - f. Vapor Permeance: 0.01 perms; ASTM E 96, Water Method.
    - g. Water Absorption: 0.5 percent; ASTM D 570.

## 2.2 ELEVATOR PIT FLUID APPLIED WATERPROOFING

- A. Location: Positive side, vertical wall application.
- B. Two component, synthetic rubber, cold vulcanized, fluid applied waterproofing membrane: Comply with ASTM C 836 and with manufacturer's written physical requirements.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. GCP Applied Technologies Inc.; Procor 75 Spray Grade with Procor Composite Membrane.
    - b. Polyguard Products, Inc.; Commercial Stretch.
    - c. W.R. Meadows, Inc.; MEL-ROL LM (ALL-SEASON).

## 2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Penetration and Terminations:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. GCP Applied Technologies Inc; Preprufe CJ Tape and Bithuthene Liquid Membrane.
    - b. Polyguard Products, Inc.; Detail Sealant PW.
    - c. W.R. Meadows, Inc.; MEL-PRIME.

## 2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Non-woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 100 sieve laminated to 1 side with a polymeric film bonded to the other side of a 3-dimensional, non-biodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of at least 15 gpm per ft.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - d. GCP Applied Technologies Inc; Hydroduct 220.
    - e. Polyguard Products, Inc.; Polyflow 10P.
    - f. W.R. Meadows, Inc.; Mel-Drain 5035-B.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
  - 1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 3. Notify Architect in writing of anticipated problems using waterproofing over substrate.
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- D. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- E. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

### 3.3 SHEET WATERPROOFING APPLICATION

- A. Install sheet waterproofing according to manufacturer's written instruction.
- B. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- C. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- D. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- E. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches (150 mm) beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

### 3.4 PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and ASTM C 1471 and manufacturer's written instructions.
- B. Prime substrate unless otherwise instructed by waterproofing manufacturer.
- C. On vertical surfaces, apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
  - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

### 3.5 JOINT AND CRACK TREATMENT AT FLUID APPLIED SYSTEMS

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 and ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
  - 1. Comply with ASTM C 1193 for joint-sealant installation.
  - 2. Apply bond breaker between sealant and preparation strip.
  - 3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches (75 mm) along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
  - 4. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

### 3.6 FLUID APPLIED WATERPROOFING APPLICATION

- A. Apply waterproofing according to ASTM C 898 and ASTM C 1471 and manufacturer's written instructions.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Apply primer (pre-treatment) over prepared substrate per manufacturer's recommendations.
- D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
  - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with dry film thickness of 60 mils. Apply waterproofing to prepared wall terminations and vertical surfaces.
  - 2. Verify wet film thickness of waterproofing every 100 sq. ft.

3.7 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Lap edges and ends of geotextile to maintain continuity. Protect installed panels during subsequent construction.

3.8 PROTECTION AND CLEANING

- A. Protect waterproofing from damage and wear during remainder of construction period.
- B. Protect installed from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION**



## SECTION 07 21 00

### THERMAL INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Polyisocyanurate foam-plastic board.
  - 2. Glass-fiber blanket.
  - 3. Mineral-wool blanket.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

#### PART 2 - PRODUCTS

##### 2.1 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Atlas Roofing Corporation; EnergyShield CGF Pro.
    - b. Firestone Building Products; Enverge CI Glass Faced.
    - c. Hunter Panels; Xci CG.
    - d. Rmax, Inc.; a Sika company; Durasheath.
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

##### 2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corporation; NoiseReducer Sound Attenuation and Acoustical Ceiling Batts.
    - b. Knauf Insulation; EcoBatt Unfaced with ECOSE Technology.
    - c. Owens Corning; EcoTouch PINK Fiberglas Insulation (unfaced).

##### 2.3 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Industrial Insulation Group, LLC a division of Johns Manville; TempControl Batts .
    - b. Roxul Inc.; COMFORTBATT.
    - c. Thermafiber, Inc.; an Owens Corning company; UltraBatt.

## 2.4 MINERAL-WOOL BOARD

- A. Mineral-Wool Board, Types IA and IB, Unfaced: ASTM C 612, Types IA and IB; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 4 lb/cu. ft. (64 kg/cu. m).
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Industrial Insulation Group, LLC, a division of Johns Manville; JM Cladstone Water and Fire Block.
    - b. Thermafiber, Inc.; an Owens Corning company; Thermafiber RainBarrier HD.

## 2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc; Series T TACTOO Insul-Hangers.
    - b. Gemco; Spindle Type.
  - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
  - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Gemco; 90-Degree Insulation Hangers.
  - 2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
  - 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc; RC150.
    - b. Gemco; Dome-Cap.
  - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
    - a. Crawl spaces.
    - b. Ceiling plenums.
    - c. Attic spaces.
- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Gemco; Clutch Clip.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. AGM Industries, Inc; TACTOO Adhesive.
    - b. Gemco; Tuff Bond Hanger Adhesive.

## 2.6 01 25 00ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

- C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.
- D. Hexagonal Wire Mesh:
  - 1. Hot dip galvanized.
  - 2. Wire Gage: 13 mm.
  - 3. Aperture: 2-1/2 inches.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

#### **3.2 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

#### **3.3 INSTALLATION OF CAVITY-WALL INSULATION**

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
  - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

#### **3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION**

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

#### **3.5 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION**

## SECTION 07 27 26

### FLUID-APPLIED MEMBRANE AIR BARRIERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Medium-build air barriers, vapor permeable.

##### 1.2 DEFINITIONS

- A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
  - 1. Medium-build air barriers, vapor permeable.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
  - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 3. Include details of interfaces with other materials that form part of air barrier.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - 1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
  - 1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.

- b. Include junction with roofing membrane, building corner condition,.
  - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  - 1. Protect substrates from environmental conditions that affect air-barrier performance.
  - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

### **PART 2 - PRODUCTS**

#### 2.1 SOURCE LIMITATIONS

- A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested in accordance with ASTM E2357.
- C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa) pressure difference; ASTM E2178.
- D. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
- E. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested in accordance with ASTM D4541.
- F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- G. UV Resistance: Can be exposed to sunlight for 180 days in accordance with manufacturer's written instructions.

#### 2.3 MEDIUM-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. Medium-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 16 to 34 mils (0.41 to 0.86 mm) over smooth, void-free substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dupont; Tyvek Fluid-Applied WB+.
    - b. TK Products; Airmax 2104
    - c. WR Meadows; Air-Shield LMP.
  - 2. Vapor Permeance: Minimum 12 perms; ASTM E96/E96M, Procedure B, Water Method.

#### 2.4 ACCESSORY MATERIALS

- A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless steel fasteners.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  - 3. Verify that substrates are visibly dry and free of moisture.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- F. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- G. Bridge discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

#### **3.3 INSTALLATION OF ACCESSORIES**

- A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
  - 1. Transition Strip: Roll firmly to enhance adhesion.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

### 3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Medium-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
  - 1. Vapor-Permeable, Medium-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.5 FIELD QUALITY CONTROL

- A. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Air-barrier dry film thickness.
  - 3. Continuous structural support of air-barrier system has been provided.
  - 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 5. Site conditions for application temperature and dryness of substrates have been maintained.
  - 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 7. Surfaces have been primed, if applicable.
  - 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 9. Termination mastic has been applied on cut edges.
  - 10. Strips and transition strips have been firmly adhered to substrate.
  - 11. Compatible materials have been used.
  - 12. Transitions at changes in direction and structural support at gaps have been provided.

13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  14. All penetrations have been sealed.
- B. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
  2. Remove and replace deficient air-barrier components for retesting as specified above.
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.
- 3.6 CLEANING AND PROTECTION
- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
  2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

**END OF SECTION**



## SECTION 07 42 13.13

### FORMED METAL WALL PANELS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Concealed-fastener, lap-seam metal wall panels.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
  2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
  4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
  5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
  6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
  7. Review temporary protection requirements for metal panel assembly during and after installation.
  8. Review of procedures for repair of metal panels damaged after installation.
  9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
  2. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  3. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical metal panel assembly as directed by Architect, including corner, supports, attachments, and accessories.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

#### 1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.7 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Finish Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
  3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
  1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## 2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Alcoa Architectural Products (USA).
    - b. ATAS International, Inc.
    - c. Berridge Manufacturing Company.
    - d. CENTRIA Architectural Systems.
    - e. Holcim; Elevate Metal Wall Systems.
    - f. MBCI; a division of NCI Group, Inc.
    - g. Morin - A Kingspan Group Company.
    - h. PAC-CLAD Petersen; a Carlisle company.
  2. Basis-of-Design Product: PAC-CLAD Petersen; a Carlisle company; Flush Wall Panel.
  3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Nominal Thickness: 0.028 inch (0.71 mm).
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: As scheduled.
  4. Panel Coverage: 12 inches (305 mm).
  5. Panel Height: 1.0 inch (25 mm).
- C. Box-Rib-Profile, Concealed-Fastener Metal Wall Panels: Formed with raised, box-shaped ribs, evenly spaced across panel width, and with rib/recess sides angled 60 degrees or more.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. AEP Span; A BlueScope Steel Company.
    - b. Alcoa Architectural Products (USA).
    - c. Industrial Building Panels, Inc.
    - d. MBCI; a division of NCI Group, Inc.
    - e. PAC-CLAD Petersen; a Carlisle company.
    - f. VICWEST.
  2. Basis-of-Design Product: PAC-CLAD Petersen; a Carlisle company; Precision Series, Box Rib 3.
  3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
    - a. Nominal Thickness: 0.028 inch (0.71 mm).
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range.
  4. Rib Spacing: Manufacturer's standard.
  5. Panel Coverage: 12 inches.
  6. Panel Height: 1-3/8 inches.

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

### 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

### 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Steel Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

#### **3.3 METAL PANEL INSTALLATION**

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
  - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
  - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
    1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
  - F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
    1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
    2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- 3.4 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal wall panel installation, including accessories.
  - B. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
  - C. Prepare test and inspection reports.
- 3.5 CLEANING AND PROTECTION
- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
  - B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
  - C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

## SECTION 07 42 93

### SOFFIT PANELS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes metal soffit panels.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
  - 2. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 3. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, tests performed by a qualified testing agency.

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof eave, including fascia, and soffit as shown on Drawings; approximately four panels wide by full eave width, including attachments and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AEP Span; a BlueScope Steel company.
    - b. ATAS International, Inc.
    - c. Berridge Manufacturing Company.



- d. CENTRIA Architectural Systems.
- e. Firestone Metal Products, LLC.
- f. MBCI; a division of NCI Building Systems, L.P.
- g. PAC-CLAD Petersen; a Carlisle company.
2. Basis-of-Design Product: PAC-CLAD Petersen; a Carlisle company; Flush Soffit Panel.
3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
  - a. Nominal Thickness: 0.028 inch (0.71 mm).
  - b. Exterior Finish: Two-coat fluoropolymer.
  - c. Color: As scheduled.
4. Panel Coverage: 12 inches (305 mm).
5. Panel Height: 1.0 inch (25 mm).

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
  2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

### 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  - 1. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
    - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
  - 1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

### 3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Shim or otherwise plumb substrates receiving metal panels.
  2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Apply panels and associated items true to line for neat and weathertight enclosure.
  2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

### 3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

## SECTION 07 52 16

### STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

#### 1.1 SUMMARY

- A. Section Includes:
1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
  2. Roof insulation.
  3. Cover board.
  4. Walkways.

#### 1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  5. Review structural loading limitations of roof deck during and after roofing.
  6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
  7. Review governing regulations and requirements for insurance and certificates if applicable.
  8. Review temporary protection requirements for roofing system during and after installation.
  9. Review roof observation and repair procedures after roofing installation.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:
1. Layout and thickness of insulation.
  2. Base flashings and membrane terminations.
  3. Flashing details at penetrations.
  4. Tapered insulation, including slopes.
  5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
  6. Crickets, saddles, and tapered edge strips, including slopes.
  7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  8. Tie-in with adjoining air barrier.
- C. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Manufacturer Certificates:
    - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
      - a. Submit evidence of complying with performance requirements.
    - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
  - C. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.
  - D. Evaluation Reports: For components of membrane roofing system, from ICC-ES.
  - E. Sample Warranties: For manufacturer's special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For roofing system to include in maintenance manuals.
  - B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
  - B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
  - B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
    - 1. Protect stored liquid material from direct sunlight.
    - 2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
  - C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
    - 1. Store in a dry location.
    - 2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
  - D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.
- 1.9 FIELD CONDITIONS
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- 1.10 WARRANTY
- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
    - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
    - 2. Warranty Period: 20 years from date of Substantial Completion.
  - B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and walkway products, for the following warranty period:
    - 1. Warranty Period: Two years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
  - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
  - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746/D 3746M, ASTM D 4272/D 4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
  - 1. Zone 1 (Roof Area Field): In accordance with local conditions and code.
  - 2. Zone 2 (Roof Area Perimeter): In accordance with local conditions and code.
  - 3. Zone 3 (Roof Area Corners): In accordance with local conditions and code.
- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency.
  - 1. Identify products with appropriate markings of applicable testing agency.
- E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.
  - 1. Identify products with appropriate markings of applicable testing agency.

### **2.2 MANUFACTURERS**

- A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

### **2.3 BASE SHEET MATERIALS**

- A. SBS-Modified Bitumen Base Sheet:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Elevate.
    - b. GAF.
    - c. Henry Company.
    - d. Johns Manville; a Berkshire Hathaway company.
    - e. Polyglass USA, Inc.
    - f. Soprema, Inc..
    - g. Tremco Incorporated.
- B. Asphalt-Coated Fiberglass Mat Base Sheet: ASTM D 4601/D 4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
- C. Vented Base Sheet: ASTM D 4897/D 4897M, Type II, venting, nonperforated, asphalt-impregnated and -coated, glass-fiber base sheet with mineral granule surfacing on bottom surface.

### **2.4 INTERPLY SHEETS**

- A. Glass-Fiber Interply Sheet: ASTM D 2178/D 2178M, Type IV, asphalt-impregnated, glass-fiber felt.

### **2.5 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET**

- A. Roofing Cap Sheet:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Elevate.
    - b. GAF.
    - c. Henry Company.
    - d. Johns Manville; a Berkshire Hathaway company.

- e. Polyglass USA, Inc.
- f. Soprema, Inc..
- g. Tremco Incorporated.

## 2.6 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 6164/D 6164M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for application method specified.
- B. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, granule surfaced, suitable for application method specified, and as follows:
  - 1. Granule Color: As selected by Architect from manufacturer's full range.
- C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668/D 1668M, Type I.
- D. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

## 2.7 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  - 1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- C. Roof Vents: As recommended by roof membrane manufacturer.
  - 1. Size: Not less than 4-inch (100-mm) diameter.
- D. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Cold-Applied Asphalt Adhesive: ASTM D 3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.
- G. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required by roofing system manufacturer for application.
- H. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
- I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- J. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve; color to match roof membrane.
- K. Aggregate Surfacing: ASTM D 1863/D 1863M, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges.
- L. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

## 2.8 ROOF INSULATION

- A. General: Preformed roof insulation boards, manufactured or approved by roof membrane manufacturer,.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - a. Atlas Roofing Corporation; ACFoam-II.
    - b. CertainTeed Corporation; FlintBoard ISO.
    - c. Hunter Panels; H-Shield.
  - 2. Compressive Strength: 20 psi (138 kPa).



3. Size: 48 by 48 inches (1219 by 1219 mm).
  4. Thickness: As indicated on Drawings but no less than minimum required by building code (continuous insulation) Long Term Thermal Resistance (LTTR) value as determined in accordance with CAN/ULC-S770 and the corresponding thickness required to meet this minimum requirement.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
1. Material: Match roof insulation.
  2. Minimum Thickness: 1/4 inch (6 mm).
  3. Slope:
    - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.
- 2.9 INSULATION ACCESSORIES
- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Insulation Cant Strips: ASTM C 728, perlite insulation board.
- E. Wood Nailer Strips: Comply with requirements in Section 06 10 53 "Miscellaneous Rough Carpentry."
- F. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum board or ASTM C 1278/C 1278M, fiber-reinforced gypsum board.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - a. CertainTeed Corporation; GlassRoc Roof Board.
    - b. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
    - c. National Gypsum Company; DEXcell FA Glass Mat Roof Board.
    - d. USG Corporation; Securock Glass Mat Roof Board.
  2. Thickness: 1/2 inch (13 mm).
  3. Surface Finish: Factory primed.
- 2.10 ASPHALT MATERIALS
- A. Asphalt Primer: ASTM D 41/D 41M.
- B. Roofing Asphalt: ASTM D 312/D 312M, Type III or IV as recommended by roofing system manufacturer for application.
- 2.11 WALKWAYS
- A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 1/2 inch (13 mm) thick, minimum.
1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm).
  2. Color: Contrasting with cap sheet.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
  2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Structural Engineer's documents.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.
  - 1. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
  - 1. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
- D. Perform fastener-pullout tests according to roof system manufacturer's recommendations.
  - 1. Submit test result within 24 hours of performing tests.
    - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

### 3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.
  - 1. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.
- D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified in Section 07 27 26 "Fluid-Applied Membrane Air Barriers."
- E. Asphalt Heating:
  - 1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.
    - a. For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.
  - 2. Circulate asphalt during heating.
  - 3. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.
    - a. For cap sheets, comply with cap sheet manufacturer's recommendations.
  - 4. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
  - 5. Do not heat asphalt within 25 deg F (14 deg C) of flash point.
  - 6. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
  - 7. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    - a. For cap sheets, comply with cap sheet manufacturer's recommendations.
- F. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.
- G. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

### 3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Nailers Strips: Mechanically fasten 4-inch nominal- (89-mm actual-) width, wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:
  - 1. 16 feet (4.88 m) apart for roof slopes greater than 1 inch per 12 inches (1:12) but less than 3 inches per 12 inches (3:12).
  - 2. 48 inches (1219 mm) apart for roof slopes greater than 3 inches per 12 inches (3:12).

- D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F (14 deg C).
- E. Installation Over Metal Decking:
1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows.
    - a. Locate end joints over crests of decking.
    - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    - d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
      - 1) Trim insulation, so that water flow is unrestricted.
    - e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    - f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    - g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
      - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
  2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.
    - a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
    - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    - d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
    - e. Trim insulation, so that water flow is unrestricted.
    - f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    - g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    - h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
      - 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

### 3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. At internal roof drains, conform to slope of drain sump.
    - a. Trim cover board, so that water flow is unrestricted.
  3. Cut and fit cover board tight to nailers, projections, and penetrations.
  4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
    - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- B. Install sheathing paper over cover board and immediately beneath roof membrane.

### 3.6 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

- C. Where roof slope exceeds 1/2 inch per 12 inches (1:24), install roofing membrane sheets parallel with slope.
  - 1. Backnail roofing sheets to nailer strips according to roofing system manufacturer's written instructions.
- D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - 1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
  - 2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
  - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.7 BASE SHEET INSTALLATION

- A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.
- B. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.
- C. Installation of SBS-Modified Bitumen Base Sheet:
  - 1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
  - 2. Extend roofing sheets over and terminate above cants.
  - 3. Install base sheet in a shingle fashion.
  - 4. Adhere to substrate in a uniform coating of cold-applied adhesive.
  - 5. Install base sheet without wrinkles, rears, and free from air pockets.
  - 6. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
    - a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    - b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    - c. Stagger end laps not less than 18 inches (450 mm).
    - d. Heat weld end laps, leaving no voids.
    - e. Roll laps with a 20-pound (9-kg) roller.
  - 7. Repair tears and voids in laps and lapped seams not completely sealed.
  - 8. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

### 3.8 INSTALLATION OF INTERPLY SHEETS

- A. Install two ply sheets, starting at low point of roofing.
  - 1. Align ply sheets without stretching.
  - 2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.
    - a. Shingle in direction to shed water.
  - 3. Extend ply sheets over and terminate above cants.

### 3.9 SBS-MODIFIED BITUMINOUS CAP SHEET INSTALLATION

- A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.
- B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
  - 1. Extend cap sheet over and terminate above cants.
  - 2. Install cap sheet in a shingle fashion.
  - 3. Install cap sheet without wrinkles or tears, and free from air pockets.
  - 4. Install cap sheet, so side and end laps shed water.
- C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
  - 1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).

2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
  3. Stagger end laps not less than 18 inches (450 mm).
  4. Heat weld laps, leaving no voids.
  5. Roll laps with a 20-pound (9-kg) roller.
  6. Repair tears and voids in laps and lapped seams not completely sealed.
- D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.
- E. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

### 3.10 FLASHING AND STRIPPING INSTALLATION

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
1. Prime substrates with asphalt primer if required by roofing system manufacturer.
  2. Backer Sheet Application:
    - a. Seal all laps.
  3. Flashing Sheet Application: Torch apply flashing sheet to substrate.
    - a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.
- B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
  1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement].
- D. Install liquid flashing system according to manufacturer's recommendations.
  1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
  2. Embed granules, matching color of roof membrane, into wet compound.
- E. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.
- F. Roof Drains: Set 30-by-30-inch- (760-by-760-mm-) 4-pound (1.8 kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.
  1. Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of 4 inches (100 mm) beyond edge of metal flashing onto field of roofing membrane.
  2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
  3. Install stripping according to roofing system manufacturer's written instructions.

### 3.11 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.
1. Install walkways at the following locations:
    - a. Perimeter of each rooftop unit.
    - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    - d. Top and bottom of each roof access ladder.
    - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    - f. Locations indicated on Drawings.
    - g. As required by roof membrane manufacturer's warranty requirements.
  2. Provide 3-inch (76-mm) clearance between adjoining pads.
  3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
  - 1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
    - a. Perform tests before overlying construction is placed.
    - b. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (51 mm) of clearance from top of base flashing.
    - c. Flood each area for 24 hours.
    - d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.
      - 1) Cost of retesting is the responsibility of the Contractor.
    - e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.
  - 2. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.
- C. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
  - 1. Determine approximate quantities of components within roofing membrane according to ASTM D 3617/D 3617M.
  - 2. Examine test specimens for interply voids according to ASTM D 3617/D 3617M and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
  - 3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
- D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
  - 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
- E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- F. Roofing system will be considered defective if it does not pass tests and inspections.
  - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

### 3.13 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period.
  - 1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION**

## SECTION 07 62 00

### SHEET METAL FLASHING AND TRIM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Manufactured reglets with counterflashing.
  - 2. Formed roof-drainage sheet metal fabrications.
  - 3. Formed low-slope roof sheet metal fabrications.
  - 4. Formed equipment support flashing.

##### 1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each of the following
  - 1. Underlayment materials.
- B. Shop Drawings: For sheet metal flashing and trim.
  - 1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
  - 2. Include plans, elevations, sections, and attachment details.
  - 3. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
  - 4. Include identification of material, thickness, weight, and finish for each item and location in Project.
  - 5. Include details for forming, including profiles, shapes, seams, and dimensions.
  - 6. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  - 7. Include details of termination points and assemblies.
  - 8. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  - 9. Include details of roof-penetration flashing.
  - 10. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  - 11. Include details of special conditions.
  - 12. Include details of connections to adjoining work.
  - 13. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.
- D. Sample Warranty: For special warranty.

##### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
  - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
  - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

#### 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

#### 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
  - 1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).
    - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
      - 1) Run grain of directional finishes with long dimension of each piece.
      - 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A755/A755M.
  - 1. Surface: Smooth, flat.
  - 2. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 3. Color: As selected by Architect from manufacturer's full range.



4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

### 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.; Miradri 860/861.
    - b. GCP Applied Technologies Inc.; Grace Ultra.
    - c. Henry Company; Blueskin PE200HT.
    - d. Polyguard Products, Inc.; Deck Guard HT.
  2. Source Limitations: Obtain underlayment from single source from single manufacturer.
  3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C) or lower.

### 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- D. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- E. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
  1. Source Limitations: Obtain reglets from single source from single manufacturer.
  2. Material: Galvanized steel, 0.022 inch (0.56 mm) thick.
  3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  4. Accessories:
    - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
  5. Finish: With manufacturer's standard color coating.

## 2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
  - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams:
  - 1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- H. Do not use graphite pencils to mark metal surfaces.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters:
  - 1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
  - 2. Fabricate in minimum 96-inch- (2400-mm-) long sections.
  - 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
  - 4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
  - 5. Gutter Profile: Style A, or as otherwise indicated on drawings, in accordance with cited sheet metal standard.
  - 6. Expansion Joints: Lap type.
  - 7. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.
  - 8. Gutters with Girth 16 to 20 Inches (410 to 510 mm): Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- B. Downspouts: Fabricate downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
  - 1. Fabricated Hanger Style: Fig. 1-35A , unless otherwise indicated on drawings, in accordance with SMACNA's "Architectural Sheet Metal Manual."
  - 2. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

- C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- E. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
  - 1. Stainless Steel: 0.019 inch (0.48 mm) thick.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) : Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
  - 1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
  - 2. Fabricate with scuppers spaced 10 feet (3 m) apart, to dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
  - 3. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
  - 1. Coping Profile: Fig. 3-4A in accordance with SMACNA's "Architectural Sheet Metal Manual."
  - 2. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
  - 3. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch (1.02 mm) thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.
- E. Flashing Receivers: Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- G. Roof-Drain Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.

## 2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
  2. Prime substrate if recommended by underlayment manufacturer.
  3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
  4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses.
  5. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller.
  6. Roll laps and edges with roller.
  7. Cover underlayment within 14 days.

### 3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
  6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  8. Do not field cut sheet metal flashing and trim by torch.
  9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
  2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

### 3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
  - 1. Join sections with joints sealed with sealant.
  - 2. Provide for thermal expansion.
  - 3. Attach gutters at eave or fascia to firmly anchor them in position.
  - 4. Provide end closures and seal watertight with sealant.
  - 5. Fasten gutter spacers to front and back of gutter.
  - 6. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
  - 7. Anchor gutter with gutter brackets spaced not more than 24 inches (600 mm) apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
  - 8. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet (15.2 m) apart. Install expansion-joint caps.
- C. Downspouts:
  - 1. Join sections with 1-1/2-inch (38-mm) telescoping joints.
  - 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
  - 3. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
  - 4. Where indicated, provide elbows at base of downspout to direct water away from building.
  - 5. Where indicated, connect downspouts to underground drainage system.
- D. Splash Pans:
  - 1. Set in elastomeric sealant compatible with the substrate.
- E. Parapet Scuppers:
  - 1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  - 2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
  - 3. Loosely lock front edge of scupper with conductor head.
  - 4. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch (25 mm) below discharge.
- G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

### 3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.
  - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  - 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
  - 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
  - 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
  - 3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- C. Copings:
  - 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
  - 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
    - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch (600-mm) centers.
    - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
  - D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
    1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
    2. Extend counterflashing 4 inches (100 mm) over base flashing.
    3. Lap counterflashing joints minimum of 4 inches (100 mm).
    4. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
  - E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.
- 3.6 INSTALLATION OF MISCELLANEOUS FLASHING
- A. Equipment Support Flashing:
    1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
    2. Weld or seal flashing with elastomeric sealant to equipment support member.
- 3.7 INSTALLATION TOLERANCES
- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- 3.8 CLEANING
- A. Clean off excess sealants.
- 3.9 PROTECTION
- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
  - B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
  - C. Maintain sheet metal flashing and trim in clean condition during construction.
  - D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

**END OF SECTION**

## SECTION 07 62 10

### FLEXIBLE FLASHING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Formed Products: Concealed flashing within wall assemblies to protect and shed incidental water to the exterior that is not specified as part of the air/moisture barrier system.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. General: Flashing and trim assemblies as indicated shall withstand structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
  - 1. Submit documentation of compatibility with air/moisture barrier.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store flashing materials in contact with other materials that might cause staining, denting, or other surface damage. Store flashing materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

#### PART 2 - PRODUCTS

##### 2.1 FLEXIBLE FLASHING

- A. Self-Adhesive flexible flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mils.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advanced Building Products Inc.; Strip-N-Flash.
    - b. Carlisle Coatings & Waterproofing; CCW-705 Air & Vapor Barrier Strips.
    - c. GCP Applied Technologies Inc.; Perm-A-Barrier Wall Membrane.
    - d. Henry; Blueskin SA

##### 2.2 HIGH TEMPERATURE FLASHING

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by manufacturer.
  - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
  - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
  - b. GCP Applied Technologies Inc.; Grace Ultra.
  - c. Henry Company; Blueskin PE200 HT.
  - d. Owens Corning; WeatherLock Specialty Tile & Metal High Temperature Underlayment.

### 2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, separators, sealants, and other miscellaneous items as required for complete metal flashing installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
  1. Verify compliance with requirements for installation tolerances of substrates.
  2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FLASHING INSTALLATION

- A. General: Install as indicated on Drawings and per Manufacturer's recommendations.
- B. Self-Adhering Sheet Flashing: Install self-adhering sheet flashing, wrinkle free. Apply primer if required by flashing manufacturer. Comply with temperature restrictions of flashing manufacturer for installation. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover flashing with subsequent construction within 14 days.
- C. Location:
  1. Flexible Flashing: As indicated on drawings, or at all exterior windows, doors or other penetrations where high temperature flashing is not required.
  2. High Temperature Flashing: As indicated on drawings, or at all locations where flashing will be in contact with metal coping or metal panels where high temperatures exist.

**END OF SECTION**



## SECTION 07 71 29

### MANUFACTURED ROOF EXPANSION JOINTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Flanged bellows-type roof expansion joints.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roof expansion joints.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
  - 3. Provide isometric drawings of intersections, terminations, changes in joint direction or planes, and transition to other expansion joint systems depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of roofing membrane.

##### 1.5 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof expansion joints that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than five Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint seals, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

##### 2.2 FLANGED BELLOWS-TYPE ROOF EXPANSION JOINTS

- A. Flanged Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof, joint cover consisting of exposed membrane bellows laminated to flexible, closed-cell support foam, and secured along each edge to 3- to 4-inch- (76- to 100-mm-) wide metal flange.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
    - b. Balco, Inc.
    - c. C/S Group.

- d. InPro Corporation.
  - e. Johns Manville; a Berkshire Hathaway company.
  - f. MM Systems Corporation.
  - g. Watson Bowman Acme Corp.
  2. Basis-of-Design Product: InPro Corporation; Model 674-G02-050.
  3. Source Limitations: Obtain flanged bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
  4. Joint Movement Capability: Plus and minus 50 percent of joint size.
  5. Bellows: EPDM flexible membrane, nominal 60 mils (1.5 mm) thick.
  6. Flanges: Galvanized steel, 0.022 inch (0.56 mm) thick.
  7. Configuration: As indicated on Drawings.
  8. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
  9. Cover Membrane: EPDM flexible membrane, factory laminated to bellows and covering entire joint assembly and curbs.
    - a. Color: Black.
  10. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
  11. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.
    - a. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture as indicated on Drawings.
    - b. Thermal Insulation: Fill space above secondary seal with mineral-fiber blanket insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
- B. Materials:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, hot-dip zinc-coating designation G90 (Z275).
  2. EPDM Membrane: ASTM D 4637/D 4637M, type standard with manufacturer for application.
- 2.3 MISCELLANEOUS MATERIALS
- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.
- B. Mineral-Fiber Blanket: ASTM C 665.
- C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine joint openings, substrates, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.
  1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
  2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  3. Provide for linear thermal expansion of roof expansion joint materials.
  4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
  5. Provide uniform, neat seams.
  6. Install roof expansion joints to fit substrates and to result in watertight performance.

- B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.
- C. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.
  - 1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.
- D. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

**END OF SECTION**

**SECTION 07 72 00**  
**ROOF ACCESSORIES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Roof curbs.
  - 2. Equipment supports.
  - 3. Roof hatches.
  - 4. Heat and smoke vents.
  - 5. Pipe and duct supports.
  - 6. Pipe portals.

1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
  - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
  - 2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: As indicated on Drawings.

## 2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported
- D. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch (1.32 mm) thick.
  - 1. Finish: Mill phosphatized.
- E. Construction:
  - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
  - 3. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
  - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
  - 5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
  - 6. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
  - 7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
  - 8. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
  - 9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
  - 10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- (19-mm-) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
  - 11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
  - 12. Damper Tray: Provide damper tray or shelf with opening 3 inches (76 mm).

## 2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced perimeter metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Adaptable Air Products.
    - b. AES Industries, Inc.
    - c. Air Balance; a division of MESTEK, Inc.
    - d. Conn-Fab Sales, Inc.
    - e. KCC International Inc.
    - f. Lloyd Industries, Inc.
    - g. LMCurbs.
    - h. Louvers & Dampers, Inc.; a division of Mestek, Inc.
    - i. Milcor; Commercial Products Group of Hart & Cooley, Inc.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch (1.32 mm) thick.
  - 1. Finish: Mill phosphatized.
- E. Construction:
  - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
  - 3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
  - 4. Nailer: Factory-installed continuous wood nailers 3-1/2 inches (90 mm) wide on top flange of equipment supports, continuous around support perimeter.
  - 5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
  - 6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- (19-mm-) thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
  - 7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
  - 8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
  - 9. Fabricate equipment supports to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
  - 10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

#### 2.4 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single -walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
  - 1. Manufacturers: Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Acudor Products, Inc.
    - b. AES Industries, Inc.
    - c. Babcock-Davis Hatchways, Inc.
    - d. Bilco Company (The).
    - e. Custom Solution Roof and Metal Products.
    - f. Dur-Red Products.
    - g. Metallic Products Corp.
    - h. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    - i. Nystrom Products Co.
    - j. O'Keeffe's Inc.
- B. Type and Size: Single-leaf lid, as indicated.
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet.
  - 1. Thickness: 0.079 inch (2.01 mm).
  - 2. Finish: Mill phosphatized.
- E. Construction:
  - 1. Insulation: 1-inch- (25-mm-) thick, glass-fiber board.
    - a. R-Value: 4.3 according to ASTM C 1363.
  - 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  - 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  - 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.

5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
  6. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
- F. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide two-point latch on lids larger than 84 inches (2130 mm).
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches (1060 mm) above finished roof deck.
  2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
  3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
  4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
  5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
  6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  8. Fabricate joints exposed to weather to be watertight.
  9. Fasteners: Manufacturer's standard, finished to match railing system.
  10. Finish: Manufacturer's standard.
    - a. Color: As selected by Architect from manufacturer's full range.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  2. Height: 42 inches (1060 mm) above finished roof deck.
  3. Material: Steel tube.
  4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
  5. Finish: Manufacturer's standard baked enamel or powder coat.
    - a. Color: As selected by Architect from manufacturer's full range.
- 2.5 HEAT AND SMOKE VENTS
- A. Hatch-Type Heat and Smoke Vents: Manufacturer's standard, with single-walled insulated curbs, welded or mechanically fastened and sealed corner joints, integral condensation gutter, and cap flashing. Fabricate with insulated double-walled lid and continuous weathertight perimeter lid gaskets, and equip with automatic self-lifting mechanisms and UL-listed fusible links rated at 165 deg F (74 deg C).
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babcock-Davis.
  2. Bilco Company (The).
  3. J.L. Industries, Inc.
  4. Milcor, Inc.
  5. Nystrom.
  6. O'Keeffe's, Inc.
- C. Basis-of-Design Product: Bilco Company (The); Type DSH-Automatic Smoke Vent.
1. Type and Size: Double-leaf lid, size as indicated.
  2. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 30-lbf/sq. ft. (1.4-kPa) internal uplift load.
    - a. When release is actuated, lid shall open against 10-lbf/sq. ft. (0.5-kPa) snow or wind load and lock in position.
  3. Heat and Smoke Vent Standard: Provide units that have been tested and listed to comply with UL 793.
  4. Curb, Framing, and Lid Material: Zinc-coated (galvanized) steel sheet.
    - a. Thickness: 0.079 inch (2.01 mm).
    - b. Finish: Baked enamel or powder coat.
    - c. Color: As selected by Architect from manufacturer's full range.
  5. Construction:
    - a. Insulation: 1-inch- (25-mm-) thick, glass-fiber board.

- b. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  - c. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  - d. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
  - e. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
  - f. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
6. Hardware: Manufacturer's standard corrosion resistant; with hinges, hold-open devices, and independent manual-release devices for inside operation of lids.

## 2.6 PIPE AND DUCT SUPPORTS

- A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch- (38-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with polycarbonate roller carrying assembly accommodating up to 7-inch- (178-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- C. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless-steel threaded rod designed for adjusting support height, accommodating up to 18 inch (457 mm) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.
- D. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches (50 mm) in diameter; accommodating up to 7-inch- (178-mm-) diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless-steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.
- E. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch- (508-mm-) diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. MIRO Industries.
    - b. Pate Company (The).
    - c. PHP Systems/Design.
    - d. Thaler Metal Industries Ltd.

## 2.7 PIPE PORTALS

- A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
- B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.



## 2.8 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
  - 1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
  - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 (AZM150) coated.
  - 1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
- C. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- D. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- E. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- F. Steel Tube: ASTM A 500/A 500M, round tube.
- G. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- H. Steel Pipe: ASTM A 53/A 53M, galvanized.

## 2.9 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.
- D. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.
- E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.
- F. Security Grilles: 3/4-inch (19-mm) diameter, ASTM A 1011/A 1011M steel bars spaced 6 inches (150 mm) o.c. in one direction and 12 inches (300 mm) o.c. in the other; factory finished as follows:
  - 1. Surface Preparation: Remove mill scale and rust, if any, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
  - 2. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
  - 3. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer; selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats under prolonged exposure.
- G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- H. Underlayment:
  - 1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

2. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
    3. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
    4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
  - I. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
  - J. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
  - K. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
  - L. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.
- 2.10 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Install roof accessories according to manufacturer's written instructions.
  1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  1. Coat concealed side of stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
  3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

- E. Roof-Hatch Installation:
    - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
    - 2. Attach safety railing system to roof-hatch curb.
    - 3. Attach ladder-assist post according to manufacturer's written instructions.
  - F. Heat and Smoke Vent Installation:
    - 1. Install heat and smoke vent so top perimeter surfaces are level.
    - 2. Install and test heat and smoke vents and their components for proper operation according to NFPA 204.
  - G. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
    - 1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - H. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.
  - I. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.
- 3.3 REPAIR AND CLEANING
- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
  - B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."
  - C. Clean exposed surfaces according to manufacturer's written instructions.
  - D. Clean off excess sealants.
  - E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

**END OF SECTION**

**SECTION 07 81 00**  
**APPLIED FIREPROOFING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes sprayed fire-resistive materials.

1.2 DEFINITIONS

- A. SFRM: Sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
  - 1. Extent of fireproofing for each construction and fire-resistance rating.
  - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 4. Treatment of fireproofing after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups to set quality standards for materials and execution.
  - 1. Build mockup of each type of fireproofing and different substrate as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F (7 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

### **2.2 SPRAYED FIRE-RESISTIVE MATERIALS**

- A. Standard Durability SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. GCP Applied Technologies; Monokote MK-6 Series
    - b. Carbolite Company; RPM International; AD Southwest Fireproofing Type 5GP
    - c. Isolatek International, Inc; Cafco 300
  - 2. Application: Designated for interior locations and concealed conditions by a qualified testing agency acceptable to authorities having jurisdiction.
  - 3. Bond Strength: Minimum 200-lbf/sq. ft.) cohesive and adhesive strength based on field testing according to ASTM E 736.
  - 4. Density: Not less than 15 lb/cu. ft. and as specified in the approved fire-resistance design, according to ASTM E 605.
  - 5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
  - 6. Combustion Characteristics: ASTM E 136.
  - 7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 0.
    - b. Smoke-Developed Index: 0.
  - 8. Compressive Strength: Minimum 10 lbf/sq. in. according to ASTM E 761.
  - 9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
  - 10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
  - 11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
  - 12. Air Erosion: Maximum weight loss of 0.0 g/sq. ft. in 24 hours according to ASTM E 859.
  - 13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
  - 14. Finish: Spray-textured finish
    - a. Color: As selected by Architect from manufacturer's full range.

### **2.3 AUXILIARY MATERIALS**

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
  - 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.
1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
  2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck is complete before beginning fireproofing work.
- C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.
- D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

#### **3.3 APPLICATION**

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
  2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

- D. Metal Decks:
    - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
    - 2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
  - E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
  - F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
  - G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
  - H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
  - I. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
  - J. Cure fireproofing according to fireproofing manufacturer's written instructions.
  - K. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
  - L. Finishes: Where indicated, apply fireproofing to produce the following finishes:
    - 1. Spray-Textured Finish: Finish left as spray applied with no further treatment.
    - 2. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.
- 3.4 FIELD QUALITY CONTROL
- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
    - 1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials."
  - B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
  - C. Fireproofing will be considered defective if it does not pass tests and inspections.
    - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
    - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
  - D. Prepare test and inspection reports.
- 3.5 CLEANING, PROTECTING, AND REPAIRING
- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
  - B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
  - C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
  - D. Repair fireproofing damaged by other work before concealing it with other construction.
  - E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

**END OF SECTION**

## SECTION 07 84 13

### PENETRATION FIRESTOPPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.
  - 3. Penetrations in smoke barriers.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.
- B. Product Certificates:
  - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the firestopping products for installation with or near its piping system.
  - 2. Certifying the firestopping products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by firestopping manufacturer.

##### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

##### 1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.



- C. Ensure firestopping products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
  - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."
      - 3) FM Global in its "Building Materials Approval Guide."

### **2.2 PENETRATION FIRESTOPPING SYSTEMS**

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any. Provide firestopping, including products specified in Section 07 84 43 "Joint Firestopping," by same manufacturer as products of this section regardless of installer. All firestopping products within this section shall be of one manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. GCP Applied Technologies Inc.
    - d. Hilti, Inc.
    - e. Johns Manville.
    - f. Nelson Firestop Products.
    - g. RectorSeal Corporation.
    - h. Specified Technologies Inc.
    - i. Tremco, Inc.; Tremco Fire Protection Systems Group.
    - j. USG Corporation.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
  - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
  - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  - 1. Permanent forming/damming/backing materials.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.

## 2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

## 2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Ensure penetration firestopping products are coordinated and compatible with one another, with the substrates forming openings, and with penetrating items.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing and inspecting agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under "Firestop Systems."
- C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."
- D. Refer to Drawings.

**END OF SECTION**

## SECTION 07 84 43

### JOINT FIRESTOPPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Joints in or between fire-resistance-rated constructions.
  - 2. Joints at exterior curtain-wall/floor intersections.
  - 3. Joints in smoke barriers.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
  - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.
- B. Product Certificates:
  - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the joint firestopping products for installation with or near its piping system.
  - 2. Certifying the joint firestopping products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by firestopping manufacturer.

##### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

##### 1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.
- C. Ensure joint firestopping products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
  - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
      - 1) UL in its "Fire Resistance Directory."
      - 2) Intertek Group in its "Directory of Listed Building Products."

### 2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases. Provide firestopping, including products specified in Section 07 84 13 "Penetration Firestopping," by same manufacturer as products of this section regardless of installer. All firestopping products within this section shall be of one manufacturer.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. GCP Applied Technologies Inc.
    - d. Hilti, Inc.
    - e. Johns Manville
    - f. Nelson Firestop Products.
    - g. RectorSeal Corporation.
    - h. Specified Technologies Inc.
    - i. Tremco, Inc.; Tremco Fire Protection Systems Group
    - j. USG Corporation.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
  - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
  - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. A/D Fire Protection Systems Inc.
    - b. GCP Applied Technologies Inc.
    - c. Hilti, Inc.
    - d. Johns Manville
    - e. Nelson Firestop Products.
    - f. RectorSeal Corporation.
    - g. Specified Technologies Inc.
    - h. 3M Fire Protection Products.
    - i. Tremco, Inc.; Tremco Fire Protection Systems Group
    - j. USG Corporation.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. 3M Fire Protection Products.
    - b. A/D Fire Protection Systems Inc.
    - c. GCP Applied Technologies Inc.
    - d. Hilti, Inc.
    - e. Johns Manville
    - f. Nelson Firestop Products.
    - g. RectorSeal Corporation.
    - h. Specified Technologies Inc.
    - i. Tremco, Inc.; Tremco Fire Protection Systems Group
    - j. USG Corporation.
  3. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

#### **3.3 INSTALLATION**

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

### 3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

### 3.8 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- A. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under product category Firestop Systems.

### 3.9 FIRE-RESISTIVE JOINT SYSTEMS

- A. Refer to Drawings.

**END OF SECTION**



## SECTION 07 91 00

### PREFORMED JOINT SEALS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Preformed, foam joint seals.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each preformed joint seal product.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of preformed joint seal required, provide Samples with joint seals in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint seals.
- D. Preformed Joint Seal Schedule: Include the following information:
  - 1. Joint seal location and designation.
  - 2. Joint width and movement capability.
  - 3. Joint seal manufacturer and product name.
  - 4. Joint seal color.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each preformed joint seal for tests performed by manufacturer and witnessed by a qualified testing agency.

##### 1.4 QUALITY ASSURANCE

- A. Mockups: Install mockups of assemblies specified in other Sections that are indicated to receive preformed joint seals specified in this Section. Use materials and installation methods specified in this Section.

##### 1.5 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace preformed joint seals that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 PREFORMED, FOAM JOINT SEALS

- A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. EMSEAL Joint Systems, Ltd.
    - b. LymTal International Inc.
    - c. MM Systems Corporation.
    - d. Nystrom, Inc.
    - e. Pecora Corporation.

- f. Sandell Manufacturing Co., Inc.
- g. Schul International Company, Inc.
- h. Watson Bowman Acme Corp.
- 2. Design Criteria:
  - a. Nominal Joint Width: As indicated on Drawings.
  - b. Movement Capability: -25 percent/+25 percent.
- 3. Joint Seal Color: As selected by Architect from full range of industry colors.

## 2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed-joint seal performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:
  - 1. Remove foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION

- A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

- B. Installation of Preformed, Foam Joint Seals:
  - 1. Install each length of seal immediately after removing protective wrapping.
  - 2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
  - 3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
  - 4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

#### 3.4 PROTECTION

- A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated seals immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION**

## SECTION 07 92 00

### JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Nonstaining silicone joint sealants.
  - 2. Urethane joint sealants.
  - 3. Mildew-resistant joint sealants.
  - 4. Butyl joint sealants.
  - 5. Latex joint sealants.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Product Certificates:
  - 1. Certifying the non-metallic plumbing piping system and the fire sprinkler piping system manufacturers evaluated and approved the joint sealant products for installation with or near its piping system.
  - 2. Certifying the joint sealant products comply with NFPA 13 requirements for material compatibility with non-metallic pipe and tubing.
- E. Field-Adhesion-Test Reports: For each sealant application tested.
- F. Sample Warranties: For special warranties.

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

## 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
  3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
  4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
  5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
  7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each kind of sealant and joint substrate.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

## 1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.8 COORDINATION

- A. Ensure joint sealant products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

## 1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: From date of Substantial Completion.
    - a. Urethane Sealants: 10 years.
    - b. Silicone Sealants: 20 years.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
  - 1. For penetrations involving CPVC piping, provide through-penetration firestop systems which include materials that have been tested to be compatible with CPVC piping.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
  - 1. Products: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 795 Silicone Building Sealant (VOC: 28 g/L).
    - b. GE Construction Sealants; Momentive Performance Materials Inc; SCS9000 SilPruf NB (VOC: 37 g/L).
    - c. Pecora Corporation; 864NST (VOC: <100 g/L).
    - d. Sika Corporation Industry Products; Sikasil WS-295 FPS (VOC: 37 g/L)
    - e. Tremco Inc., Tremco CS&W Group; Spectrem 2 (VOC: 42 g/L).

### 2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  - 1. Products: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Master Builders Solutions Construction Systems US, LLC; Aktiengesellschaft; MasterSeal TX1 (VOC: 36 g/L).
    - b. C.R. Laurence Co, Inc.; CRL M64 (VOC: 9 g/L).
    - c. Pecora Corporation; DynaTrol I-XL (VOC: <100 g/L).
    - d. Sika Corporation Industry Products; Sikaflex Textured Sealant.
    - e. Tremco Inc., Tremco CS&W Group; Vulkem 116 (49 g/L).
- B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Master Builders Solutions Construction Systems US, LLC; Aktiengesellschaft; MasterSeal SL 1 (VOC: 104 g/L).

- b. Pecora Corporation; Urexpam NR-201 (VOC: <50 g/L).
          - c. Sika Corporation Industry Products; Sikaflex 1c SL (VOC: 40 g/L).
    - C. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
      - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        - a. LymTal International, Inc.; Iso-Flex 888QC.
- 2.4 MILDEW-RESISTANT JOINT SEALANTS
- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
  - B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. C.R. Laurence Co, Inc.; CRL 33S Silicone (VOC: 30 g/L).
      - b. Dow Corning Corporation; 786 Silicone Sealant (VOC: 33 g/L).
      - c. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary (VOC: 20 g/L).
      - d. Pecora Corporation; Pecora 898NST (VOC: 50 g/L).
      - e. Sika Corporation Industry Products; Sikasil GP (VOC: 29 g/L).
      - f. Soudal Accumetric; Silirub RTV1 (VOC: 30 g/L).
      - g. Tremco Inc., Tremco CS&W Group; Tremsil 200 (VOC: 1 g/L).
- 2.5 BUTYL JOINT SEALANTS
- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. C.R. Laurence Co, Inc.; CRL 777 Butyl Rubber (VOC: 240 g/L)..
      - b. Pecora Corporation; BC-158 (VOC: <250 g/L).
      - c. Tremco Inc., Tremco CS&W Group; Butyl Sealant (VOC: 232 g/L)
- 2.6 LATEX JOINT SEALANTS
- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. C.R. Laurence Co, Inc.; CRL 321 (VOC: 22 g/L).
      - b. Pecora Corporation; AC-20 (VOC: 20 g/L).
      - c. Tremco Incorporated; Tremflex 834 (VOC: 31 g/L).
- 2.7 JOINT-SEALANT BACKING
- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Alcot Plastics Ltd.; Alcot Plastics Backer Rod.
      - b. Master Builders Solutions Construction Systems US, LLC; Aktiengesellschaft; MasterSeal 920.
  - B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  - C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.



- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
  - 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
  - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
  - 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Joints between different materials listed above.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints in exterior insulation and finish systems.
    - d. Joints between metal panels.
    - e. Joints between different materials listed above.
    - f. Perimeter joints between materials listed above and frames of openings.
    - g. Control and expansion joints in overhead surfaces.
    - h. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in ceramic tile flooring.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Ceramic tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of walls and partitions.
    - d. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, S, NS, 25, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  - 1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors and elevator entrances.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Acrylic latex.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Concealed mastics.
1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Butyl-rubber based.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

**END OF SECTION**

## SECTION 07 92 19

### ACOUSTICAL JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes acoustical joint sealants.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Acoustical-Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Sample Warranties: For special warranties.

##### 1.4 COORDINATION

- A. Ensure joint sealant products are coordinated and compatible with the non-metallic plumbing piping system and the fire sprinkler piping system.

##### 1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Compatibility: Provide sealants composed of components that are compatible with each other, substrates forming openings, and items penetrating sealant under conditions of service and application.
  - 1. For penetrations involving CPVC piping, provide sealants which include materials that have been tested to be compatible with CPVC piping.

##### 2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Franklin International; Titebond GREENchoice Professional Acoustical Smoke & Sound Sealant.

- b. GE Construction Sealants; Momentive Performance Materials Inc.
  - c. Grabber Construction Products.
  - d. Hilti, Inc.
  - e. OSI Sealants; Henkel Corporation.
  - f. Pecora Corporation; Pecora AIS-919 Acoustical and Insulation Latex Sealant.
  - g. United States Gypsum Company; SHEETROCK Acoustical Sealant
2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

### 2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION**

## SECTION 07 95 13.13

### INTERIOR EXPANSION JOINT COVER ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes interior expansion joint cover assemblies.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
  - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
  - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
  - 1. Manufacturer and model number for each expansion joint cover assembly.
  - 2. Expansion joint cover assembly location cross-referenced to Drawings.
  - 3. Nominal, minimum, and maximum joint width.
  - 4. Movement direction.
  - 5. Materials, colors, and finishes.
  - 6. Product options.
  - 7. Fire-resistance ratings.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.

##### 1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockup of typical expansion joint cover assembly as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.
  - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.
- B. Expansion Joint Design Criteria:
  - 1. Type of Movement: Thermal.
    - a. Nominal Joint Width: As indicated on Drawings.
    - b. Minimum Joint Width: As indicated on Drawings.
    - c. Maximum Joint Width: As indicated on Drawings.

## 2.3 WALL EXPANSION JOINT COVERS

- A. Metal-Plate Wall Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
    - b. Balco, Inc.
    - c. Construction Specialties, Inc.
    - d. InPro Corporation (IPC).
    - e. MM Systems Corporation.
    - f. Nystrom, Inc.
    - g. Watson Bowman Acme Corp.
  - 2. Basis-of-Design Product: InPro Corporation (IPC); 118 Series.
  - 3. Application: As indicated.
  - 4. Fire-Resistance Rating: Not less than that of adjacent construction.
  - 5. Exposed Metal:
    - a. Aluminum: Clear anodic, Class I.

## 2.4 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
  - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- C. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## 2.6 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
  - 1. Provide where indicated on Drawings.
- B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.



- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
  - 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
  - 2. Install frames in continuous contact with adjacent surfaces.
    - a. Shimming is not permitted.
  - 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
  - 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- D. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- E. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
  - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- F. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

### 3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

**END OF SECTION**

## SECTION 08 11 13

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
  - 2. Exterior standard steel doors and frames.

##### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

##### 1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 7. Details of anchorages, joints, field splices, and connections.
  - 8. Details of accessories.
  - 9. Details of moldings, removable stops, and glazing.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

##### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
  - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
  - 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
  - 3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Field quality control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ceco Door; ASSA ABLOY.
  - 2. Curries Company; ASSA ABLOY.
  - 3. DE LA FONTAINE.
  - 4. Fleming Door Products Ltd.; ASSA ABLOY.
  - 5. Gensteel Doors, Inc.
  - 6. Hollow Metal Xpress.
  - 7. Mesker Door Inc.
  - 8. Republic Doors and Frames.
  - 9. Steelcraft; an Allegion brand.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
  - 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft. (2.84 W/K x sq. m) when tested in accordance with ASTM C518.

#### 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..
  - 1. Doors:
    - a. Thickness: 1-3/4 inches (44.5 mm).
    - b. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    - c. Edge Construction: Model 2, Seamless.
    - d. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - e. Core: Manufacturer's standard.
    - f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Face welded.
  - 3. Exposed Finish: Prime.

#### 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm).
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
    - h. Core: Polyurethane.
    - i. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
  - 2. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
    - b. Construction: Full profile welded.
  - 3. Exposed Finish: Prime.

#### 2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- B. Construction: Face welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

#### 2.6 HOLLOW-METAL PANELS

- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

#### 2.7 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
  3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

## 2.8 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

## 2.9 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.

2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

## 2.10 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
  3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  4. Solidly pack mineral-fiber insulation inside frames.
  5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
  2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
  3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  - 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
  - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

### 3.4 REPAIR

- A. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION**

**SECTION 08 14 16**  
**FLUSH WOOD DOORS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Five-ply flush wood veneer-faced doors for transparent finish.
  - 2. Factory finishing flush wood doors.
  - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
  - 1. Door core materials and construction.
  - 2. Door edge construction
  - 3. Door face type and characteristics.
  - 4. Factory-machining criteria.
  - 5. Factory- finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
  - 1. Door schedule indicating door location, type, size, fire protection rating, and swing.
  - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
  - 3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 4. Dimensions and locations of blocking for hardware attachment.
  - 5. Dimensions and locations of mortises and holes for hardware.
  - 6. Clearances and undercuts.
  - 7. Requirements for veneer matching.
  - 8. Doors to be factory finished and application requirements.
- C. Samples for Verification:
  - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.5 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.



- C. Mark each door on bottom rail with opening number used on Shop Drawings.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Delamination of veneer.
    - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
    - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
  - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain flush wood doors from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C.
  - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

#### 2.3 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards." and ANSI/WDMA I.S. 1A.
  - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

#### 2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Eggers Industries.
    - b. Lambton Doors.
    - c. Masonite Architectural.
    - d. Oshkosh Door Company.
    - e. VT Industries Inc.
  - 2. Performance Grade:
    - a. ANSI/WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
    - b. ANSI/WDMA I.S. 1A Extra Heavy Duty: public toilets, janitor's closets, exits, and where indicated on Drawings.

3. Architectural Woodwork Standards Grade: Custom.
4. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.
  - a. Species and Cut: As scheduled.
  - b. Match between Veneer Leaves: Book match.
  - c. Assembly of Veneer Leaves on Door Faces: Center-balance match.
  - d. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  - e. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
  - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
  - b. Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.
    - 1) Finish steel edges and astragals with baked enamel same color as doors.
  - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: 475 lbf (2110 N) in accordance with WDMA T.M. 10.
6. Core for Non-Fire-Rated Doors:
  - a. ANSI A208.1, Grade LD-1 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
    - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 08 71 00 "Door Hardware."
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
  - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.5 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
  1. Wood Species: Same species as door faces.
  2. Profile: Manufacturer's standard shape.
  3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

## 2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
  1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
  1. Locate hardware to comply with DHI-WDHS-3.
  2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
  3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."
- 2.7 FACTORY FINISHING
- A. Comply with referenced quality standard for factory finishing.
1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  2. Finish faces, all four edges, edges of cutouts, and mortises.
  3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
1. Architectural Woodwork Standards Grade: Custom.
  2. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
  3. Staining: Match WD-1, as approved by Architect.
  4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
  5. Sheen: Satin.

### **PART 3 - EXECUTION**

- 3.1 EXAMINATION
- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
1. Install fire-rated doors and frames in accordance with NFPA 80.
  2. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- 3.3 FIELD QUALITY CONTROL
- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
  2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

**END OF SECTION**

## SECTION 08 31 13

### ACCESS DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For access doors and frames.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspecting agency.
  - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

##### 1.5 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

##### 2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Acudor Products, Inc.
    - b. Babcock-Davis.
    - c. J. L. Industries; a division of Activar Construction Products Group.
    - d. Karp Associates, Inc.
    - e. Larsen's Manufacturing Company.
    - f. Milcor Inc.
    - g. Nystrom, Inc.
  - 2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
  - 3. Locations: Wall and ceiling.
  - 4. Door Size: As indicated.
  - 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
  - 6. Stainless Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage, ASTM A480/A480M No. 4 finish.
  - 7. Frame Material: Same material and thickness as door.
  - 8. Latch and Lock: Cam latch, screwdriver operated.

- B. Recessed Access Doors with Concealed Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Acudor Products, Inc.
    - b. Babcock-Davis.
    - c. Bauco Access Panel Solutions Inc.
    - d. J. L. Industries; a division of Activar Construction Products Group.
    - e. Karp Associates, Inc.
    - f. Larsen's Manufacturing Company.
    - g. Milcor Inc.
    - h. Nystrom, Inc.
  - 2. Description: Door face recessed 5/8 inch (16 mm) for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
  - 3. Locations: Ceiling.
  - 4. Door Size: As indicated.
  - 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
  - 6. Stainless Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage, ASTM A480/A480M No. 4 finish.
  - 7. Latch and Lock: Cam latch, screwdriver operated.

## 2.3 FIRE-RATED ACCESS DOORS AND FRAMES

- A. Fire-Rated, Flush Access Doors with Concealed Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Acudor Products, Inc.
    - b. Babcock-Davis.
    - c. J. L. Industries; a division of Activar Construction Products Group.
    - d. Karp Associates, Inc.
    - e. Larsen's Manufacturing Company.
    - f. Milcor Inc.
    - g. Nystrom, Inc.
  - 2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
  - 3. Locations: Wall.
  - 4. Door Size: As indicated.
  - 5. Fire-Resistance Rating: Not less than that of adjacent construction.
  - 6. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.
  - 7. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage, factory primed.
  - 8. Frame Material: Same material, thickness, and finish as door.
  - 9. Latch and Lock: Self-closing, self-latching door hardware, operated by knurled-knob.

## 2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

## 2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
    - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
  - D. Latch and Lock Hardware:
    - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
- 2.6 FINISHES
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  - C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
  - D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
    - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
  - E. Stainless Steel Finishes:
    - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    - 2. Polished Finish: ASTM A480/A480M No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
    - 3. Run grain of directional finishes with long dimension of each piece.
      - a. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

#### 3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80.

#### 3.4 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

3.5 SCHEDULE

- A. Provide access doors where indicated and in the following locations:
  - 1. Access required by code.
  - 2. Access required for servicing operable, adjustable, or resettable fire suppression, plumbing, mechanical, electrical, life safety, security, and communication systems.
- B. Sizes: Provide the following unless noted otherwise:
  - 1. Ceilings and Soffits: 24 inches by 24 inches minimum.
  - 2. Toilet Rooms: 12 inches by 12 inches minimum at each fixture chase wall.
- C. Materials:
  - 1. Uncoated steel sheet unless noted otherwise.
  - 2. Stainless Steel:
    - a. Toilet rooms.
    - b. Walls scheduled to receive tile finish, epoxy paint, or FRP panels.

**END OF SECTION**



**SECTION 08 33 23**  
**OVERHEAD COILING DOORS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Service doors.
  - 2. Insulated service doors.
  - 3. Fire-rated service doors.
  - 4. Fire-rated, insulated service doors.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of overhead coiling door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
  - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and testing and inspecting agency.
  - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.
  - 2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Sample Warranty: For special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
  - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling-door manufacturer.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers include, but are not limited to, the following:
  - 1. Cookson Company.
  - 2. Cornell Iron Works, Inc.
  - 3. Overhead Door Corporation.
  - 4. Raynor.
  - 5. Wayne-Dalton Corp.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.
- B. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".
- C. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: According to ASTM E 330/E 330M.
  - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
  - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

#### 2.3 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
    - a. Include tamperproof cycle counter.
  - 2. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.
  - 3. Door Curtain Material: Galvanized steel.
  - 4. Door Curtain Slats: Flat F-265 profile slats of 2-5/8-inch (67-mm) center-to-center height.
    - a. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
  - 5. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from aluminum extrusions and finished to match door.
  - 6. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
  - 7. Hood: Galvanized steel.
    - a. Shape: As indicated on Drawings.
    - b. Mounting: As indicated on Drawings.
  - 8. Locking Devices: Equip door with slide bolt for padlock.
    - a. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumbturn.
  - 9. Manual Door Operator: Push-up operation.

10. Electric Door Operator:
    - a. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
    - b. Operator Location: As indicated on Drawings.
    - c. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
    - d. Motor Exposure: Interior.
    - e. Motor Electrical Characteristics: As recommended by manufacturer.
    - f. Emergency Manual Operation: Push-up type.
    - g. Obstruction-Detection Device: Automatic photoelectric sensor ; self-monitoring type.
      - 1) Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
    - h. Control Station(s): Where indicated on Drawings.
  11. Curtain Accessories: Equip door with smoke seals, weatherseals, push/pull handles, and automatic-closing device.
  12. Door Finish:
    - a. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
- B. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
1. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
    - a. Include tamperproof cycle counter.
  2. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.
  3. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu (0.792 K x sq. m/W).
  4. Door Curtain Material: Galvanized steel.
  5. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
    - a. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
  6. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from aluminum extrusions and finished to match door.
  7. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
  8. Hood: Galvanized steel.
    - a. Shape: As indicated on Drawings.
    - b. Mounting: As indicated on Drawings.
  9. Locking Devices: Equip door with locking device assembly.
    - a. Locking Device Assembly: Cremona-type, both jamb sides locking bars, operable from inside with thumbturn.
  10. Manual Door Operator: Push-up operation.
  11. Electric Door Operator:
    - a. Operator Location: As indicated on Drawings.
    - b. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
    - c. Motor Exposure: Interior.
    - d. Motor Electrical Characteristics: As recommended by manufacturer.
    - e. Obstruction-Detection Device: Automatic ; self-monitoring type.
      - 1) Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
  12. Curtain Accessories: Equip door with push/pull handles.
  13. Door Finish:
    - a. Factory Prime Finish: Manufacturer's standard color.
- 2.4 FIRE-RATED DOOR ASSEMBLY
- A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - a. Advanced Door Technologies; Overhead Coiling Doors – Fire Rated.
    - b. C.H.I. Overhead Doors, Inc.; Rolling Fire Doors 7000 Series.
    - c. Clopay Building Products; Fire Rated Service Doors (Insulated or Non-insulated).

- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Fire Rating: 3/4 hour and 1-1/2 hours, where indicated, and with smoke control.
- D. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.
- E. Curtain R-Value: Manufacturer's standard.
- F. Door Curtain Material: Galvanized steel.
- G. Door Curtain Slats: Flat profile slats of 1-7/8-inch (48-mm) center-to-center height.
- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
  - 1. Shape: As indicated on Drawings.
  - 2. Mounting: As indicated on Drawings.
- J. Manual Door Operator: Push-up operation.
  - 1. Provide operator with through-wall shaft operation.
- K. Electric Door Operator:
  - 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
  - 2. Operator Location: As indicated on Drawings.
  - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
  - 4. Motor Exposure: Interior.
  - 5. Motor Electrical Characteristics: As recommended by manufacturer.
  - 6. Emergency Manual Operation: Push-up type.
  - 7. Obstruction-Detection Device: Automatic photoelectric sensor.
    - a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
  - 8. Control Station(s): Interior mounted.
- L. Curtain Accessories: Equip door with smoke seals, automatic-closing device, push/pull handles.
- M. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

## 2.5 FIRE-RATED INSULATED SERVICE DOOR ASSEMBLY

- A. Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Advanced Door Technologies.
    - b. C.H.I. Overhead Doors, Inc.
    - c. Clopay Building Products.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Fire Rating: 3/4 hour and 1-1/2 hours, where indicated, and with smoke control.
- D. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.
- E. Door Curtain Material: Galvanized steel.
- F. Door Curtain Slats: Curved profile slats of 1-7/8-inch (48-mm) center-to-center height.
  - 1. Insulated-Slat Interior Facing: Metal.
- G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

- H. Hood: Match curtain material and finish.
  - 1. Shape: As indicated on Drawings.
  - 2. Mounting: As indicated on Drawings.
- I. Manual Door Operator: Push-up operation.
  - 1. Provide operator with through-wall shaft operation.
- J. Electric Door Operator:
  - 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
  - 2. Operator Location: As indicated on Drawings.
  - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
  - 4. Motor Exposure: Interior.
  - 5. Motor Electrical Characteristics: As recommended by manufacturer.
  - 6. Emergency Manual Operation: Push-up type.
  - 7. Obstruction-Detection Device: Automatic photoelectric sensor.
    - a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
  - 8. Control Station(s): Interior mounted.
- K. Curtain Accessories: Equip door with smoke seals, automatic-closing device, push/pull handles.
- L. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

## 2.6 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.7 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
  - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
  - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

## 2.8 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
  - 2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
  - 3. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

## 2.9 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: As standard with manufacturer.
  - 2. Keys: Three for each cylinder.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## 2.10 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
  - 1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
  - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- D. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Automatic-closing device shall be designed for activation by the following:
  - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.
  - 2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
  - 3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
  - 4. Building fire-detection, smoke-detection, and -alarm systems.

## 2.11 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
  - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.12 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).

## 2.13 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-rewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Comply with NFPA 70.
  - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
  - 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
  - 2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
  - 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
  - 4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
  - 5. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
  - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
  - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.
  - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
    - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
  - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  - 2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

#### 2.14 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 2.15 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.
- F. Power-Operated Doors: Install according to UL 325.

#### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.



- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

#### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

#### 3.5 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

#### 3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

#### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION**

## SECTION 08 34 73.13

### METAL SOUND CONTROL DOOR ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes metal sound control door assemblies.

##### 1.2 COORDINATION

- A. Coordinate installation of anchorages for sound control door assemblies. Furnish setting drawings, templates, and directions for installing anchorages. Deliver sleeves, inserts, anchor bolts, and items with integral anchors to Project site in time for installation.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review procedures for coordinating frame and anchor installation with wall construction.
  - 2. Review required field quality-control procedures.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include sound ratings, construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: For sound control door assemblies.
  - 1. Include elevations of each door design.
  - 2. Include details of sound control seals, door bottoms, and thresholds.
  - 3. Include details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 4. Include frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 5. Include locations of reinforcements and preparations for hardware.
  - 6. Include details of each different wall opening condition.
  - 7. Include details of anchorages, joints, field splices, and connections.
  - 8. Include details of accessories.
  - 9. Include details of moldings, removable stops, and glazing.
  - 10. Include details of conduits and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish not less than 3 by 5 inches (76 by 127 mm.)
  - 1. Doors and Frames: Samples approximately 12 by 12 inches (305 by 305 mm).
    - a. Doors: Include section of vertical-edge, top, and bottom construction; automatic door bottom or gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
    - b. Frames: Include profile, corner joint, floor and wall anchors, and seals.
- E. Schedule: Provide a schedule of sound control door assemblies prepared using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of sound control door assembly.
- C. Product Test Reports: For each sound control door assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- E. Field quality-control reports.
- F. Sample Warranty: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound control door assemblies to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Acoustical Testing Agency Qualifications: An independent agency accredited as an acoustical laboratory according to the National Voluntary Laboratory Accreditation Program of NIST.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Avoid the use of nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-(102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sound control door assemblies that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Failure to meet sound rating requirements.
    - b. Faulty operation of sound seals.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.
  2. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide sound control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
1. STC Rating: 51 as calculated by ASTM E 413 when tested in an operable condition according to ASTM E 90.
- B. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Smoke- and Draft Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.2 STEEL SOUND CONTROL DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Ambico Limited.
  2. Amweld International, LLC.
  3. Ceco Door; ASSA ABLOY.
  4. Curries Company; ASSA ABLOY.
  5. Firedoor Corporation.
  6. Fleming Door Products Ltd.; Assa Abloy Group Company.
  7. Industrial Acoustics Company.
  8. Krieger Specialty Products Company.
  9. Noise Barriers, LLC.
  10. Overly Door Company.

11. Pioneer Industries.
  12. Security Acoustics.
- B. Source Limitations: Obtain steel sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.
- C. Doors: Flush-design sound control doors, thickness as required to provide STC rating, of seamless construction; with manufacturer's standard sound-retardant core as required to provide STC and fire rating indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to NAAMM-HMMA 865.
1. Exterior Doors: Fabricate from metallic-coated steel sheet 0.052-inch (1.32-mm) nominal thickness or thicker as required to provide STC rating indicated.
  2. Interior Doors: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.048-inch (1.21-mm) nominal thickness or thicker as required to achieve STC rating indicated.
  3. Core: Manufacturer's standard sound control core.
  4. Loose Stops for Glazed Lites in Doors: Same material as face sheets.
  5. Top and Bottom Channels: Closed with continuous channels of same material as face sheets, spot welded to face sheets not more than 6 inches (152 mm) o.c.
  6. Hardware Reinforcement: Same material as face sheets.
- D. Materials:
1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
  2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
  3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with G60 (Z180) zinc (galvanized) or A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.
  4. Glazing: As required by sound control door assembly manufacturer to comply with sound control and fire-rated-door labeling requirements.
- E. Finishes:
1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
    - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
  2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- 2.3 SOUND CONTROL FRAMES
- A. Frames: Fabricate sound control door frames with corners mitered, reinforced, and continuously welded the full depth and width of frame. Fabricate according to NAAMM-HMMA 865.
1. Weld frames according to NAAMM-HMMA 820.
  2. Exterior Frames: Fabricate from metallic-coated steel sheet 0.079-inch (2.01-mm) nominal thickness or thicker as required to provide STC rating indicated.
  3. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch (1.90-mm) nominal thickness or thicker as required to provide STC rating indicated.
  4. Hardware Reinforcement: Fabricate according to NAAMM-HMMA 865 of same material as face sheets.
  5. Head Reinforcement: Metallic-coated steel channel or angle stiffener, 0.108-inch (2.74-mm) nominal thickness.
  6. Jamb Anchors:
    - a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.064-inch (1.63-mm) nominal-thickness metallic-coated steel with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.156 inch (3.9 mm) thick.
    - b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.048-inch (1.21-mm) nominal-thickness uncoated steel unless otherwise indicated.

- c. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter, metallic-coated steel bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
  7. Floor Anchors: Not less than 0.079-inch (2.01-mm) nominal-thickness metallic-coated steel, and as follows:
    - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
    - b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.
  8. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 51-mm-) wide uncoated steel unless otherwise indicated.
  9. Plaster Guards: Metallic-coated steel sheet, not less than 0.026 inch (0.6 mm) thick.
- B. Materials:
  1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
  2. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
  3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with G60 (Z180) zinc (galvanized) or A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.
  4. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
  5. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.
  6. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound control door frames of type indicated.
  7. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.
- C. Finishes:
  1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
    - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
  2. Factory-Applied Paint Finish: Manufacturer's standard primer and finish coats, complying with SDI A250.3 for performance and acceptance criteria.
    - a. Color and Gloss: As selected by Architect from manufacturer's full range.

## 2.4 HARDWARE

- A. Sound Control Door Hardware: Manufacturer's standard sound control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC and fire rating indicated.
  1. Head and Jamb Seals: One of the following:
    - a. Neoprene Compression Seals: One-piece units consisting of closed-cell sponge neoprene seal held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
    - b. Silicone Compression Seals: One-piece units consisting of silicone compression bulb and stabilizer flange; attached to door frame adhesively.
    - c. Magnetic Seals: One-piece units consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
  2. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door.
    - a. Mounting: Mortised or semimortised into bottom of door as required by testing to achieve STC rating indicated.
  3. Door Bottoms: Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.
  4. Cam-Lift Hinges: Full-mortise template type that raises door 1/2 inch (13 mm) when door is fully open; with hardened pin; fabricated from stainless steel.

5. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum.
    - a. Finish: Clear anodic finish.
    - b. Color: As selected by Architect from full range of industry colors and color densities.
  - B. Other Hardware: Comply with requirements in Section 08 71 00 "Door Hardware."
- 2.5 SOUND CONTROL ACCESSORIES
- A. Glazing: Manufacturers' standard factory-installed glazing.
  - B. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C 143/C 143M.
  - C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- 2.6 FABRICATION
- A. Steel Sound Control Door Fabrication: Sound control doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
    1. Comply with requirements in NFPA 80 for fire-rated and smoke control doors.
    2. Seamless Edge Construction: Fabricate doors with faces joined at vertical edges by welding; welds shall be ground, filled, and dressed to make them invisible and to provide a smooth, flush surface.
    3. Exterior Doors: Close top edges flush and seal joints against water penetration. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
    4. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated. Provide fixed stops and moldings welded on secure side of door.
    5. Hardware Preparation: Factory prepare sound control doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
      - a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.
      - b. Locate door hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
    6. Tolerances: Fabricate doors to tolerances indicated in NAAMM-HMMA 865.
  - B. Sound Control Frame Fabrication: Fabricate sound control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
    1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
    2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
    3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
    4. Jamb Anchors: Provide number and spacing of anchors as follows:
      - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
        - 1) Two anchors per jamb up to 60 inches (1524 mm) in height.
        - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
        - 3) Four anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
        - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm), or fraction thereof, more than 96 inches (2438 mm) in height.
      - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
        - 1) Three anchors per jamb up to 60 inches (1524 mm) in height.
        - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
        - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) in height.
        - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm), or fraction thereof, more than 96 inches (2438 mm) in height.
        - 5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.

- c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
5. Head Reinforcement: For grouted frames more than 48 inches (1219 mm) wide, weld continuous head reinforcement to back of frame at head full width of opening.
6. Hardware Preparation: Factory prepare sound control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
  - a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
  - b. Locate hardware as indicated, or if not indicated, according to NAAMM-HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
7. Plaster Guards: Weld guards to frame at back of hardware cutouts and glazing-stop screw and sound control seal preparations to close off interior of openings in frames to be grouted.
8. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 865.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of sound control door frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace sound control door frames to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

#### **3.3 INSTALLATION**

- A. General: Install sound control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.
- B. Frames: Install sound control door frames in sizes and profiles indicated.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. At openings requiring smoke and draft control, install frames according to NFPA 105.
    - c. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, and dress; make splice smooth, flush, and invisible on exposed faces.
    - d. Install sound control frames with removable glazing stops located on secure side of opening.
    - e. Remove temporary braces only after frames or bucks have been properly set and secured.
    - f. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Apply corrosion-resistant coating to backs of frames to be filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
  4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
  7. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
  8. Installation Tolerances: Adjust sound control door frames for squareness, alignment, twist, and plumbness to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Doors: Fit sound control doors accurately in frames, within clearances indicated below. Shim as necessary.
1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
    - a. Jambs: 1/8 inch (3 mm).
    - b. Head with Butt Hinges: 1/8 inch (3 mm).
    - c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch (9.5 mm).
    - d. Sill: Manufacturer's standard.
    - e. Between Edges of Pairs of Doors: 1/8 inch (3 mm).
  2. Fire-Rated Doors: Install fire-rated doors with clearances according to NFPA 80.
- D. Sound Control Seals: Where seals have been factory prefit and preinstalled and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.
- E. Cam-Lift Hinges: Install hinges according to manufacturer's written instructions.
- F. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 07 92 00 "Joint Sealants."
- G. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with sound control door assembly manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- 3.4 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - B. Testing Services: Perform testing for verification that assembly complies with STC rating requirements.
    1. Acoustical testing and inspecting agency shall select one sound control door(s) at random from sound control door assemblies that are completely installed for testing.
    2. Field tests shall be conducted according to ASTM E 336, with results calculated according to ASTM E 413. Acceptable field NIC values shall be within 5 dB of laboratory STC values.
    3. Inspection Report: Acoustical testing agency shall submit report in writing to Architect and Contractor within 24 hours after testing.



4. If tested door fails, replace or rework all sound control door assemblies to bring them into compliance at Contractor's expense.
    - a. Additional testing and inspecting at Contractor's expense will be performed to determine if replaced or additional work complies with specified requirements.
  - C. Prepare test and inspection reports.
- 3.5 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and adjust seals, door bottoms, and other sound control hardware items right before final inspection. Leave work in complete and proper operating condition.
  - B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
    1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.
  - C. Grouted Frames: Clean grout off sound control door frames immediately after installation.
  - D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible, rust-inhibitive, air-drying primer.
  - E. Metallic-Coated Surfaces: Clean abraded areas of doors and repair with galvanizing repair paint according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 08 41 13

### ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Aluminum-framed storefront systems.
  - 2. Aluminum-framed entrance door systems.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
  - 4. Include point-to-point wiring diagrams showing the following:
    - a. Power requirements for each electrically operated door hardware.
    - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- E. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Installer and field-testing agency.
  - 2. For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Field quality-control reports.

- E. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.7 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D 4214.
    - c. Cracking, peeling, or chipping.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing accessories, from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.

- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
  - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
    - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
  - 3. Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.
- E. Structural: Test in accordance with ASTM E330/E330M as follows:
  - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
  - 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
  - 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
  - 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- H. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
  - 1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than that required by applicable building code as determined in accordance with NFRC 100.
    - b. Entrance Doors: U-factor of not more than that required by applicable building code as determined in accordance with NFRC 100.
  - 2. Solar Heat-Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than that required by applicable building code as determined in accordance with NFRC 200.
    - b. Entrance Doors: SHGC of not more than that required by applicable building code as determined in accordance with NFRC 200.

3. Air Leakage:
  - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested in accordance with ASTM E283.
  - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
  1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
  2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
    - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
    - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

## 2.3 STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Arcadia.
  2. Kawneer North America; an Arconic company.
  3. Oldcastle BuildingEnvelope.
  4. Tubelite Inc.
  5. U.S. Aluminum; a brand of C.R. Laurence.
  6. YKK AP America, Inc.
- B. Basis-of-Design Product: YKK AP America, Inc.; YES 60 TU.
- C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Exterior Framing Construction: Thermally broken.
  2. Interior Vestibule Framing Construction: Nonthermal.
  3. Glazing System: Retained mechanically with gaskets on four sides.
  4. Glazing Plane: Center.
  5. Fabrication Method: Field-fabricated stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Arcadia.
  2. Kawneer North America; an Arconic company.
  3. Oldcastle BuildingEnvelope.
  4. Tubelite Inc.
  5. U.S. Aluminum; a brand of C.R. Laurence.
  6. YKK AP America, Inc.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
  1. Door Construction:
    - a. Interior Doors – Heavy Duty: 2 -inch overall thickness, with minimum 0.1875-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - b. Exterior Doors: 2-1/4 -inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members, thermally broken. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded.
  2. Door Design: As indicated, with minimum 10 inch bottom rail.

3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.

## 2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
  1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
  2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Cylinders:
  1. As specified in Section 08 71 00 "Door Hardware."
- E. Weather Stripping: Manufacturer's standard replaceable components.
  1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
- F. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- G. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

## 2.6 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.

## 2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- E. Rigid PVC filler.

## 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using screw-spline system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.10 BRAKE METAL

- A. Material: Extruded Aluminum.
- B. Thickness: 0.090 inches (2.38mm) unless noted otherwise.
- C. Finish: Match storefront.
- D. Texture: Smooth.
- E. Profile: As indicated.

## 2.11 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
  - 1. Color: Black.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

#### **3.3 INSTALLATION OF GLAZING**

- A. Install glazing as specified in Section 08 80 00 "Glazing."

#### **3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS**

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

#### **3.5 ERECTION TOLERANCES**

- A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  - 3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
  - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

#### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.



- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
    - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.
      - a. Perform a minimum of three tests in areas as directed by Architect.
      - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
  - C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
  - D. Prepare test and inspection reports.
- 3.7 MAINTENANCE SERVICE
- A. Entrance Door Hardware Maintenance:
    - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
    - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

**END OF SECTION**

## SECTION 08 51 13

### ALUMINUM WINDOWS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes aluminum windows for exterior locations.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
  - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
  - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
  - 1. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.
  - 2. Include plans, elevations, sections, hardware, accessories, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.
- D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.

##### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

##### 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.

- b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
  - c. Faulty operation of movable sash and hardware.
  - d. Deterioration of materials and finishes beyond normal weathering.
  - e. Failure of insulating glass.
2. Warranty Period:
- a. Window: 10 years from date of Substantial Completion.
  - b. Glazing Units: 10 years from date of Substantial Completion.
  - c. Aluminum Finish: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

### **2.2 WINDOW PERFORMANCE REQUIREMENTS**

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Minimum Performance Class: As indicated on Drawings.
  2. Minimum Performance Grade: As indicated on Drawings.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of not more than that required by applicable building code.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of not more than that required by applicable building code.
- E. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.
- F. Sound Transmission Class (STC): Rated for not less than 26 STC, unless otherwise indicated, when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

### **2.3 ALUMINUM WINDOWS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Kawneer North America; an Alcoa company.
  2. Mon-Ray-Inc.
  3. YKK AP America Inc.
- B. Basis-of-Design Products:
1. Mon-Ray, Inc.; DeVAC 450 Glider.
  2. YKK AP America Inc.; YFW 400 TU.
  3. YKK AP America Inc.; YSW 400 T.
- C. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Horizontal sliding.
  2. Fixed.
- D. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

- E. Laminated Glass, Where Indicated: ASTM C 1172 with two plies of float glass.
    - 1. Float Glass: Heat strengthened or fully tempered, as indicated or required by code.
    - 2. Inner Ply: Clear.
    - 3. Interlayer: 0.090 inch (2.29 mm).
    - 4. Outer Ply: Clear.
  - F. Insulating-Glass Units, Where Indicated: ASTM E 2190.
    - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.
      - a. Tint: Clear .
      - b. Kind: Fully tempered where indicated on Drawings.
    - 2. Lites: Two.
    - 3. Filling: Fill space between glass lites with air or argon.
    - 4. Low-E Coating: Sputtered on second surface.
  - G. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
  - H. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
    - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
  - I. Horizontal-Sliding Window Hardware:
    - 1. Sill Cap/Track: Manufacturer's standard of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
    - 2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
    - 3. Roller Assemblies: Low-friction design.
  - J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
  - K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
    - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- 2.4 ACCESSORIES
- A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
  - B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
  - C. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
  - D. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.
- 2.5 FABRICATION
- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
  - B. Glaze aluminum windows in the factory.
  - C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
  - D. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- 2.6 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
  - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As selected by Architect:
  - 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - 2. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    - a. Color: As selected by Architect from full range of industry colors and color densities.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
  - 1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
  - 2. Air-Infiltration Testing:
    - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
    - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
  - 3. Water-Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
  5. Test Reports: Prepared according to AAMA 502.
  - C. Windows will be considered defective if they do not pass tests and inspections.
  - D. Prepare test and inspection reports.
- 3.4 ADJUSTING, CLEANING, AND PROTECTION
- A. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
    1. Keep protective films and coverings in place until final cleaning.
  - B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
  - C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 08 62 50

### TUBULAR DAY LIGHTING DEVICE

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Tubular day lighting device, consisting of roof dome, reflective tube, and diffuser assembly; configuration as indicated on the drawings.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Completed tubular day lighting device assemblies shall be capable of meeting the following performance requirements:
  - 1. Air Leakage Test: Air leakage will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
  - 2. Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.
  - 3. Self-Ignition Temperature, smoke-production in accordance with ASTM E 84; smoke density in accordance with ASTM D 2843.
  - 4. Uniform Load Test:
    - a. No breakage, permanent damage to fasteners, hardware parts, or damage to make system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf or Negative Load of 60 psf in accordance with ICC AC-16 Section A, or Negative Load of 70 psf if tested per ICC AC-16 Section B.
    - b. All units shall be tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.

##### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.
- C. Verification Samples: As requested by Architect.
- D. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

##### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engaged in manufacture of tubular day lighting devices for minimum 15 years.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

##### 1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

- A. Day Lighting Device: Manufacturer's standard warranty for 10 years.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Basis of Design Product: Solatube International, Inc., which is located at: 2210 Oak Ridge Way; Vista, CA 92081; Toll Free Tel: 888-765-2882; Tel: 760-477-1120; Fax: 760-597-4488; Email: request info (commsales@solatube.com); Web: www.solatube.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.

2.2 TUBULAR DAYLIGHTING DEVICES

- A. Tubular Day Lighting Devices General: Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.
- B. Tubular Daylighting Device System:
1. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
    - a. Outer Dome Glazing: Type DA, 0.125-inch minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV C), impact modified acrylic blend.
    - b. Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.
    - c. LightTracker Reflector: Aluminum sheet, thickness 0.015 inch with Spectralight Infinity. Positioned in dome to capture low angle sunlight.
  2. Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
    - a. Base Material: Sheet steel, corrosion resistant, meeting ASTM A 653/A 653M or ASTM A 463/A 463M or ASTM A792/A 792M, 0.028 inch thick plus or minus .006 inch thick.
    - b. Base Pitched: Pitched Type FP, 22.5 degrees slope from horizontal, 4 inches high.
    - c. Metal Roof Flashing Kit: Type MR. Includes Butyl tape, flashing screws, speed nuts, corner washers and polyurethane sealant.
  3. Tube Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact acrylic; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
  4. Reflective Extension Tube: Type EXX, Aluminum sheet, thickness 0.015 inch, 24 inches long. Provide in quantities as required.
    - a. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface.
    - b. Visible spectrum greater than 99 percent. Total solar spectrum less than 80.2 percent.
    - c. Color: a\* and b\* (defined by CIE L\*a\*b\* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
    - d. Tube Diameter: Approximately 10 inches.
  5. Reflective 30 degree Adjustable tube: Aluminum sheet, thickness .015 inch.
    - a. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Visible spectrum greater than 99 percent. Total solar spectrum less than 80.2 percent.
  6. Reflective 90 degree Adjustable tube: Aluminum sheet, thickness .018 inch.
    - a. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Visible spectrum greater than 99 percent. Total solar spectrum less than 80.2 percent.
    - b. Extension Tube Angle Adapter: Provide manufacturer's standard adaptors for applications requiring:
      - 1) Type A1 one 0 to 90 degree extension tube angle adapter.



7. Ceiling Ring: Injection molded, impact resistant acrylic. Nominal thickness is 0.110 inches.
8. Dual Glazed Diffuser Assembly:
  - a. Upper glazing: PET GAG plastic with EPDM low density sponge seal to minimize condensation and bug, dirt, and air infiltration per ASTM E283. The nominal thickness is 0.039 inches.
    - 1) Natural Effect Lens: Type LN.
  - b. Lower glazing (Vusion): Acrylic plastic classified as CC2 material. The nominal thickness is 0.090 inches.
  - c. Diffuser Trim Ring: Injection molded acrylic.
    - 1) White Trim (Vusion): Type L4.
9. Catalog Number: S160 DS-DA-FP-MR-EXX-A1-L4-LN

### 2.3 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.
- C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.
- C. Coordinate installation of units with substrates, air and vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that finished installation is weather tight.
- D. For sloped roof installation, install tubular unit skylights on curbs specified by manufacturer with tops of curbs parallel to finished roof slope.
- E. Where metal surfaces of tubular unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by tubular unit skylight manufacturer.
- F. Install tubular unit skylight curb counter flashing to produce weatherproof seal with curb and overlap with roofing system termination at top of curb.
- G. Provide thermal isolation when components penetrate or disrupt building insulation. Pack fibrous insulation in rough opening to maintain continuity of thermal barriers.

- H. Coordinate attachment and seal of perimeter air and vapor barrier material.
- I. Align tubular day lighting device free of warp or twist, maintain dimensional tolerances.

3.4 CLEANING

- A. Clean exposed tubular unit skylight surfaces according to manufacturer's written instructions.
- B. Remove excess sealants, glazing materials, dirt, and other substances.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

## SECTION 087100

### DOOR HARDWARE

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
  2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
  2. Electromechanical door hardware.
  3. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames".
  2. Division 08 Section "Flush Wood Doors".
  3. Division 08 Section "Sound Control Hollow Metal Door Assemblies".
  4. Division 08 Section "Sound Control Wood Door Assemblies".
  5. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  2. ICC/IBC - International Building Code.
  3. NFPA 70 - National Electrical Code.
  4. NFPA 80 - Fire Doors and Windows.
  5. NFPA 101 - Life Safety Code.
  6. NFPA 105 - Installation of Smoke Door Assemblies.
  7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
  1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.

- c. Wiring instructions for each electronic component scheduled herein.
      - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
    - D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
    - E. Informational Submittals:
      - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- 1.4 CLOSEOUT SUBMITTALS
- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
    - 1. Maintenance manual must be provided for tornado/hurricane storm shelter impact protective systems.
  - B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.
  - C. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) or acceptable integrated file format for updating of Openings Studio™ management software and as required in Division 01, Project Record Documents.
- 1.5 QUALITY ASSURANCE
- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
  - B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
  - C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
  - D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified

Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  - 3. Review sequence of operation narratives for each unique access controlled opening.
  - 4. Review and finalize construction schedule and verify availability of materials.
  - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

## 1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

## 1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

## 2.2 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:
  - a. Two Hinges: For doors with heights up to 60 inches.
  - b. Three Hinges: For doors with heights 61 to 90 inches.
  - c. Four Hinges: For doors with heights 91 to 120 inches.
  - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
  - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
  - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
  - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
  - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
  - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
  - b. Cam Lift Hinges: Where specified provide hinges that move the door up and then lower it to create a tight seal when the door is closed.
5. Manufacturers:
  - a. McKinney (MK) - TA/T4A Series, 5-knuckle.



## 2.3 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Manufacturers:
    - a. Pemko (PE).

## 2.4 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
1. Manufacturers:
    - a. Pemko (PE) - EL-CEPT Series.
    - b. Securitron (SU) - EL-CEPT Series.
  
  - B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
    1. Provide one each of the following tools as part of the base bid contract:
      - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
      - b. McKinney (MK) - Connector Hand Tool: QC-R003.
  
    2. Manufacturers:
      - a. McKinney (MK) - QC-C Series.

## 2.5 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.

3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Manufacturers:
    - a. Rockwood (RO).
- B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Manufacturers:
    - a. Rockwood (RO).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
  2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
  3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
  4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
  5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
  6. Manufacturers:
    - a. Rockwood (RO).

## 2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
1. Threaded mortise cylinders with rings and cams to suit hardware application.
  2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
  4. Tubular deadlocks and other auxiliary locks.
  5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  6. Keyway: Manufacturer's Standard.

- C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents.
  - 1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
  - 2. Manufacturers:
    - a. Corbin Russwin (RU) - Pyramid.
    - b. No Substitution.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
  - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
  - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  - 3. Existing System: Field verify and key cylinders to match Owner's existing system.
- F. Key Quantity: Provide the following minimum number of keys:
  - 1. Change Keys per Cylinder: Two (2)
  - 2. Master Keys (per Master Key Level/Group): Five (5).
  - 3. Construction Keys (where required): Ten (10).
- G. Construction Keying: Provide construction master keyed cylinders.
- H. Key Registration List (Bitting List):
  - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  - 2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.7 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
  - 1. Manufacturers:
    - a. Lund Equipment (LU).
    - b. MMF Industries (MM).
    - c. Telkee (TK).

- P. Electronic Key Management System: Provide an electronic key control system with Stand-alone Plug and Play features including advanced RFID technology. Touchscreen interface with PIN access for keys individually locked in place. Minimum 1,000 system users and 21 iFobs for locking receptors. System shall have a minimum 250,000 audit events screen displayed or ability to be exported via USB port.

1. Manufacturers:

- a. Medeco (MC).

## 2.8 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

- a. Corbin Russwin Hardware (RU) - ML2000 Series.  
b. No Substitution.

## 2.9 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

## 2.10 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as

- required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
    - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
    - b. Wire routing for all non-access control electromechanical functions and EcoFlex trim to be contained within the carrier of the device eliminating the need for cavities in doors to be drilled. Include a protective film so that wires don't get damaged if the rail needs to be removed.
    - c. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
    - d. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
    - e. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
  2. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - PED4000 / PED5000 Series.
    - b. No Substitution.

- C. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be constructed of high grade, heat treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.
1. Static Load Force Resistance: Minimum 3000 lbs. certified independent tested.
  2. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.
    - b. No Substitution.
- D. Tubular Panic Devices: ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Device to be ADA compliant requiring less than 5 lbs. of force to activate. Post mounting with optional mechanical dogging. Provide proper fasteners as required by manufacturer to meet application requirements. Provide exit devices on both leaves of pairs of doors.
1. Style: Exposed vertical rod. 1-1/4" grip diameter with interior operating panic handle in combination with exterior fixed pull handle. Panic mechanism shall be concealed within brass or stainless steel tubing. Optional entrance from exterior by a keyed cylinder.
  2. Configurations (provide as specified):
  3. Push/pull operation when dogged from the inside.
  4. Latching: Top latching. Reversed, flat, Pullman style. Roller-type latching not acceptable.
  5. Engraved "PUSH" signage with optional paint infill and boundary grooves.
  6. Manufacturers:
    - a. Rockwood (RO) - PDU8500 Series.
    - b. No Substitution.

## 2.11 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
  2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
  4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

- B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Large body cast iron surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:
  - a. Corbin Russwin Hardware (RU) - DC8000 Series.
  - b. No Substitution.

## 2.12 SURFACE MOUNTED CLOSER HOLDERS

- A. Electromagnetic Door Holders: ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Manufacturers:
  - a. Norton Rixson (RF) - 980/990 Series.
  - b. No Substitution.

## 2.13 ARCHITECTURAL TRIM

- A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
  - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
  - a. Rockwood (RO).

## 2.14 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  - 1. Manufacturers:
    - a. Rockwood (RO).

## 2.15 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
  - 1. Pemko (PE).

## 2.16 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design



complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

- a. Securitron (SU) - DPS Series.

- B. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.

1. Manufacturers:

- a. Securitron (SU) - AQD Series.

2.17 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### 3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

### 3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko

- 3. SU - Securitron
- 4. RO - Rockwood
- 5. RU - Corbin Russwin
- 6. NO - Norton
- 7. RF - Rixson
- 8. OT - Other

**Hardware Sets**

**Set: 1.0**

Doors: A101A

Description: EXTERIOR STOREFRONT PAIR CARD READER TUBULAR PANIC (BLACK FINISH)

2 Continuous Hinge	BSPFM95SLF-HD1		PE	087100	
2 Storefront Panic Device	PDU8500-3 04	BSP	RO	087100	
2 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
1 Electric Strike Kit	ESK-1600-DBL LM	BSP	RO	087100	
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	BSP	RU	087100	
1 Perimeter Seals	By Door & Frame Manufacturer		OT		
1 Rain Guard	346BSP + 4" ODW		PE	087100	
2 Sweep	345BSPNB		PE	087100	
1 Threshold	252x3BSPFG		PE	087100	
1 ElectroLynx Harness	QC-C2500P		MK	087100	⚡
1 Motion Sensor	XMS		SU	087100	⚡
2 Position Switch	DPS-M-BK		SU	087100	⚡
1 Power Supply	AQD x Amps Required		SU	087100	⚡
1 Card Reader	By Security Contractor		OT		

**Set: 2.0**

Doors: A196

Description: EXTERIOR STOREFRONT PAIR EXIT ONLY TUBULAR PANIC (BLACK FINISH)

2 Continuous Hinge	BSPFM95SLF-HD1		PE	087100	
2 Storefront Panic Device, Exit Only	PDU8500	BSP	RO	087100	
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	BSP	RU	087100	
1 Perimeter Seals	By Door & Frame Manufacturer		OT		
1 Rain Guard	346BSP + 4" ODW		PE	087100	
2 Sweep	345BSPNB		PE	087100	
1 Threshold	252x3BSPFG		PE	087100	

**Set: 3.0**

Doors: A101B

Description: EXTERIOR STOREFRONT PAIR CARD READER (BLACK FINISH) AUTO OPERATOR

2 Continuous Hinge	BSPFM95SLF-HD1 PT		PE	087100	
2 Electric Power Transfer	CEPT-10	BSP	SU	087100	⚡
1 Mullion	CR908BKM CT7R		RU	087100	
1 Rim Exit Device, Nightlatch	ED5200S K157ET M92 MELR M52	BSP	RU	087100	⚡
1 Rim Exit Device, Exit Only	ED5200S EO M92 M52	BSP	RU	087100	⚡
3 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
2 Pull	RM201	BSP	RO	087100	
1 Surface Closer w/ Hvy Dty Stop	DC8210 A11	BSP	RU	087100	
1 Automatic Opener	6071 RF	BSP	NO	087100	⚡
1 Perimeter Seals	By Door & Frame Manufacturer		OT		
1 Rain Guard	346BSP + 4" ODW		PE	087100	
2 Sweep	345BSPNB		PE	087100	
1 Threshold	252x3BSPFG		PE	087100	
2 ElectroLynx Harness	QC-C012P		MK	087100	⚡
2 ElectroLynx Harness	QC-C2500P		MK	087100	⚡
2 Door Switch	504		NO	087100	⚡
2 Position Switch	DPS-M-BK		SU	087100	⚡
1 Power Supply	AQD x Amps Required		SU	087100	⚡
1 Card Reader	By Security Contractor		OT		

**Set: 4.0**

Doors: A114B, A127A

Description: EXTERIOR HM PAIR CARD READER SVR (BLACK FINISH)

2 Continuous Hinge	BSPFM83HD1 SER12		PE	087100	
1 Electrified SVR Exit, Fail Secure	ED5400 N9905ET M55 M92 M52	BSP	RU	087100	⚡
1 Surface Vert Rod Exit, Dummy	ED5400 N950ET M55 M92 M52	BSP	RU	087100	⚡
3 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	BSP	RU	087100	
2 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100	
1 Astragal	18041BSPNB		PE	087100	
1 Rain Guard	346BSP + 4" ODW		PE	087100	
1 Gasketing	2891BSPV		PE	087100	
2 Sweep	345BSPNB		PE	087100	
1 Threshold	252x3BSPFG		PE	087100	

2 ElectroLynx Harness	QC-C2500P		MK	087100	⚡
2 ElectroLynx Harness	QC-C300P		MK	087100	⚡
2 Position Switch	DPS-M-BK		SU	087100	⚡
1 Power Supply	AQD x Amps Required		SU	087100	⚡
1 Card Reader	By Security Contractor		OT		

**Set: 5.0**

Doors: [A118](#)

Description: EXTERIOR HM PAIR EXIT ONLY STC

2 Continuous Hinge	CFM83HD1		PE	087100	
1 Mullion	CR972BKM 7'2" CT7R		RU	087100	
2 Rim Exit Device, Exit Only	ED5200S EO	630	RU	087100	
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	689	RU	087100	
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100	
1 Rain Guard	346C + 4" ODW		PE	087100	
1 Gasketing (Mullion)	5110BL		PE	087100	
1 Acoustic Seal Set (Includes STC Threshold, Astragal)	PEMKOSTCSET-2A	BL	PE	087100	
2 Door Bottom	420APKL 36"		PE	087100	

**Set: 6.0**

Doors: [A101E](#)

Description: EXTERIOR HM PAIR EXIT ONLY RIM EXIT (BLACK FINISH)

2 Continuous Hinge	BSPFM83HDI		PE	087100	
1 Mullion	CR972BKM 7'2" CT7R		RU	087100	
2 Rim Exit Device, Exit Only	ED5200S EO	BSP	RU	087100	
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	BSP	RU	087100	
1 Gasketing (Mullion)	5110BL		PE	087100	
1 Rain Guard	346BSP + 4" ODW		PE	087100	
1 Gasketing	2891BSPV		PE	087100	
2 Sweep	345BSPNB		PE	087100	
1 Threshold	252x3BSPFG		PE	087100	

**Set: 7.0**

Doors: [A117B](#)

Description: SGL CLASSROOM FUNCTION OUTSWING (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100	
1 Classroom Lock	ML2055 NSA	BSP	RU	087100	

1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8210	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 8.0**

Doors: [A349A](#), [A349B](#)

Description: SGL STOREROOM FUNCTION INSWING RATED (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Storeroom Lock	ML2057 NSA	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Wall Stop	406	BSP	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 9.0**

Doors: [A131](#)

Description: SGL STOREROOM FUNCTION INSWING RATED

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	689	RU	087100
1 Wall Stop	406	US32D	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 10.0**

Doors: [A109](#), [A120B](#), [A126](#), [A143B](#), [A145](#), [A154](#), [A203](#)

Description: SGL STOREROOM FUNCTION INSWING

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Stop (Wall / Floor)	406 / 481 To Suit	US26D	RO	087100
3 Silencer	608-RKW		RO	087100

Notes: A109, A143B, A145, A154, A203: OMIT KICK PLATE

**Set: 11.0**

Doors: [A102B](#)

Description: SGL STOREROOM FUNCTION OUTSWING

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8210	689	RU	087100
1 Stop (Wall / Floor)	406 / 481 To Suit	US26D	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 12.0**

Doors: [A117A](#)

Description: SGL STOREROOM FUNCTION INSWING WIDE STC

3 Hinge, Cam Lift	MKCL180	US32D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Stop (Wall / Floor)	406 / 481 To Suit	US26D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Threshold	151A		PE	087100

**Set: 13.0**

Doors: [A132](#), [A133](#), [A134](#), [A137](#)

Description: SGL STOREROOM FUNCTION INSWING STC

3 Hinge, Cam Lift	MKCL134 4-1/2" x 4-1/2"	US32D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	689	RU	087100
1 Stop (Wall / Floor)	406 / 481 To Suit	US26D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Threshold	151A		PE	087100



**Set: 14.0**

Doors: A207, A301A, A302B, A304

Description: SGL STOREROOM FUNCTION INSWING STC (BLACK FINISH)

3 Hinge, Cam Lift	MKCL134	BSP	MK	087100
1 Storeroom Lock	ML2057 NSA	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Wall Stop	406	US32D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Threshold	151BSP		PE	087100

Notes: A301A, A302B, A304: OMIT KICK PLATE

**Set: 15.0**

Doors: A102, A104, A107

Description: SGL STOREROOM FUNCTION INSWING (BLACK FINISH) WIDE

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	BSP	MK	087100
1 Storeroom Lock	ML2057 NSA	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 16.0**

Doors: A103B, A300, A303

Description: SGL STOREROOM FUNCTION INSWING (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Storeroom Lock	ML2057 NSA	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 17.0**

Doors: A302A

Description: SGL STOREROOM FUNCTION OUTSWING (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Storeroom Lock	ML2057 NSA	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8210	BSP	RU	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 18.0**

Doors: [A116B](#)

Description: SGL STOREROOM FUNCTION INSWING WIDE RATED

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Stop (Wall / Floor)	406 / 481 To Suit	US26D	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 19.0**

Doors: [A116D](#)

Description: SGL STOREROOM FUNCTION OUTSWING WIDE RATED CLOSER/STOP

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer w/ Stop	DC8210 A4	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 20.0**

Doors: [A124B](#), [A125](#)

Description: PAIR A/I STOREROOM FUNCTION RATED

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Dust Proof Strike	570	US26D	RO	087100
1 Flush Bolt	2945	US26D	RO	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key	Match	RU	087100

	System			
1 Coordinator	1700	US28	RO	087100
2 Surface Closer	DC8200	689	RU	087100
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
2 Wall Stop	406	US32D	RO	087100
1 Astragal	18041CNB		PE	087100
1 Gasketing	S773BL		PE	087100

**Set: 21.0**

Doors: [A143A](#)

Description: PAIR A/I STOREROOM FUNCTION

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Dust Proof Strike	570	US26D	RO	087100
1 Flush Bolt	2945	US26D	RO	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Coordinator	1700	Black	RO	087100
2 Surface Closer	DC8200	689	RU	087100
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
2 Wall Stop	406	US32D	RO	087100
1 Astragal	18041CNB		PE	087100
2 Silencer	608-RKW		RO	087100

**Set: 22.0**

Doors: [A115](#)

Description: SGL STOREROOM FUNCTION RIM EXIT RATED

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Fire Rated Rim Exit, Storeroom	ED5200SA N959ET	630	RU	087100
1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8210	689	RU	087100
1 Wall Stop	406	US32D	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 23.0**

Doors: [A123](#)

Description: SGL STOREROOM FUNCTION RIM RATED WIDE STC

3 Hinge, Cam Lift	MKCL180	US32D	MK	087100
1 Fire Rated Rim Exit, Storeroom	ED5200SA N959ET	630	RU	087100

1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8210	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Wall Stop	406	US32D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Threshold	151A		PE	087100

**Set: 24.0**

Doors: [E106B](#)

Description: SGL STOREROOM FUNCTION RIM EXIT RATED CLOSER/STOP

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Fire Rated Rim Exit, Storeroom	ED5200SA N959ET	630	RU	087100
1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer w/ Hvy Dty Stop	DC8210 A11	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 25.0**

Doors: [E101](#), [E104](#)

Description: SGL STOREROOM FUNCTION (NO CLOSER) STC

3 Hinge, Cam Lift	MKCL134 4-1/2" x 4-1/2"	US32D	MK	087100
1 Storeroom Lock	ML2057 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Wall Stop	406	US32D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Threshold	151A		PE	087100

**Set: 26.0**

Doors: [A135](#), [E100A](#), [E100B](#), [E100C](#), [E106A](#), [E106C](#)

Description: PAIR STOREROOM FUNCTION SVR STC

6 Hinge, Cam Lift	MKCL180	US32D	MK	087100
1 Surf Vert Rod, Storeroom	ED5470B N959ET M55	630	RU	087100
1 Surf Vert Rod, Dummy	ED5470B N950ET M55	630	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	689	RU	087100

2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Acoustic Seal Set (Includes STC Threshold, Astragal)	PEMKOSTCSET-2A	BL	PE	087100

Notes: AT NON-RATED OPENINGS PROVIDE ED5400 PANIC DEVICES IN LIEU OF ED5470B.

A135: OMIT KICK PLATE.

**Set: 27.0**

Doors: A111A, A146A, A206A, A208A

Description: PAIR SVR x PULLS STC (BLACK FINISH)

6 Hinge, Cam Lift	MKCL180	US32D	MK	087100
1 Surface Vert Rod Exit	PED5450T M52 K157ET M55	BSP	RU	087100
1 Surface Vert Rod Exit	PED5440 EO M55 M52	BSP	RU	087100 ⚡
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
2 Pull	RM3101-48 Mtg-Type 12XHD	BSP	RO	087100
2 Surface Closer w/ Hvy Dty Stop	DC8210 A11	BSP	RU	087100
1 Acoustic Seal Set (Includes STC Threshold, Astragal)	PEMKOSTCSET-2A	BL	PE	087100

Notes: MOUNT PULLS 7" FROM DOOR EDGE SO AS NOT TO BE AN OBSTRUCTION TO KEYED CYLINDER.

**Set: 28.0**

Doors: A135B

Description: PAIR STOREROOM FUNCTION SVR STC RATED (BLACK FINISH)

6 Hinge, Cam Lift	MKCL180	US32D	MK	087100
1 Fire Rated Surf Vert Rod, Storeroom	ED5470B N959ET M55	BSP	RU	087100
1 Fire Rated Surf Vert Rod, Dummy	ED5470B N950ET M55	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
2 Surface Closer	DC8210	BSP	RU	087100
2 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
2 Wall Stop	406	BSP	RO	087100
1 Acoustic Seal Set (Includes STC Threshold, Astragal)	PEMKOSTCSET-2A	BL	PE	087100

**Set: 29.0**

Doors: A101C

Description: PAIR STOREROOM FUNCTION SVR RATED MHO (CORRIDOR)

2 Continuous Hinge	CFM83HD1		PE	087100	
1 Surf Vert Rod, Storeroom	ED5470B N959ET M55	630	RU	087100	
1 Surf Vert Rod, Dummy	ED5470B N950ET M55	630	RU	087100	
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
2 Surface Closer	DC8210 A3	689	RU	087100	
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100	
2 Electromagnetic Holder	998M	689	RF	087100	⚡
1 Astragal	18041CNB		PE	087100	
1 Gasketing	S773BL		PE	087100	

**Set: 30.0**

Doors: [A112](#), [A127](#)

Description: PAIR STOREROOM FUNCTION SVR MHO (CORRIDOR)

2 Continuous Hinge	CFM83HD1		PE	087100	
1 Surface Vert Rod Exit, Storeroom	ED5400 N959ET M55	630	RU	087100	
1 Surface Vert Rod Exit, Dummy	ED5400 N950ET M55	630	RU	087100	
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
2 Surface Closer	DC8210 A3	689	RU	087100	
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100	
2 Electromagnetic Holder	998M	689	RF	087100	⚡
1 Astragal	18041CNB		PE	087100	
2 Silencer	608-RKW		RO	087100	

**Set: 31.0**

Doors: [A112A](#)

Description: PAIR CARD READER SVR MHO (CORRIDOR)

2 Continuous Hinge	CFM83HD1 EL-CEPTx32D		PE	087100	⚡
1 Electrified SVR Exit, Fail Secure	ED5400 N9905ET M55 M92	630	RU	087100	⚡
1 Surface Vert Rod Exit, Dummy	ED5400 N950ET M55 M92	630	RU	087100	⚡
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
2 Surface Closer	DC8210	689	RU	087100	
2 Electromagnetic Holder	998M	689	RF	087100	⚡
1 Astragal	18041CNB		PE	087100	
2 Silencer	608-RKW		RO	087100	
2 ElectroLynx Harness	QC-C2500P		MK	087100	⚡
2 ElectroLynx Harness	QC-C300P		MK	087100	⚡
2 Position Switch	DPS-W-GY		SU	087100	⚡

1 Power Supply	AQD x Amps Required	SU 087100	⚡
1 Card Reader	By Security Contractor	OT	

**Set: 32.0**

Doors: A121A

Description: PAIR STOREROOM FUNCTION RIM EXIT WIDE STC

8 Hinge, Cam Lift	MKCL180	US32D	MK	087100
1 Mullion	CR910BKM CT7R		RU	087100
1 Rim Exit Device, Storeroom	ED5200S N959ET	630	RU	087100
1 Rim Exit Device, Dummy	ED5200S N950ET	630	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
2 Surface Closer	DC8210 A3	689	RU	087100
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
2 Wall Stop	406	US32D	RO	087100
1 Gasketing	S773BL		PE	087100
1 Gasketing (Mullion)	5110BL		PE	087100
1 Acoustic Seal Set (Includes STC Threshold, Astragal)	PEMKOSTCSET-2A	BL	PE	087100

**Set: 33.0**

Doors: A300A, E100D

Description: PAIR STOREROOM FUNCTION SVR

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Surface Vert Rod Exit, Storeroom	ED5400 N959ET M55	630	RU	087100
1 Surface Vert Rod Exit, Dummy	ED5400 N950ET M55	630	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
2 Surface Closer	DC8210	689	RU	087100
2 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
2 Wall Stop	406	US32D	RO	087100
1 Astragal	18041CNB		PE	087100
1 Gasketing	S773BL		PE	087100

Notes: A300A: OMIT KICK PLATE

**Set: 34.0**

Doors: A205

Description: SGL STOREROOM FUNCTION RIM EXIT (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Rim Exit Device, Storeroom	ED5200S N959ET	BSP	RU	087100
1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer w/ Stop	DC8210 A4	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 35.0**

Doors: [A144B](#)

Description: SGL STOREROOM FUNCTION RIM EXIT RATED (BLACK FINISH) RATED

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Fire Rated Rim Exit, Storeroom	ED5200SA N959ET	BSP	RU	087100
1 Rim Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer w/ Stop	DC8210 A4	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 36.0**

Doors: [A108](#)

Description: SGL PRIVACY FUNCTION INSWING (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Privacy Lock	ML2030 NSA M19V	BSP	RU	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 37.0**

Doors: [A128B](#), [A129B](#), [A138](#)

Description: SGL PRIVACY FUNCTION INSWING

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Privacy Lock	ML2030 NSA M19V	626	RU	087100
1 Surface Closer	DC8200	689	RU	087100
1 Wall Stop	406	US32D	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 38.0**

Doors: [A128A](#), [A129A](#), [A130](#)

Description: SGL PRIVACY/ENTRANCE FUNCTION CLOSER/STOP RATED



3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK	087100
1 Entrance Lock w/ Indicator	ML2024 NSVN V33	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer w/ Stop	DC8210 A4	689	RU	087100
1 Gasketing	S773BL		PE	087100

**Set: 39.0**

Doors: [A139](#)

Description: SGL ENTRY FUNCTION CLOSER/STOP

3 Hinge, Full Mortise, Hvy Wt	T4A3786 5" x 4-1/2"	US26D	MK	087100
1 Entrance Lock	ML2024 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer w/ Stop	DC8210 A4	689	RU	087100
3 Silencer	608-RKW		RO	087100

**Set: 40.0**

Doors: [E102A](#), [E102B](#), [E103](#)

Description: SGL ENTRY FUNCTION STC

3 Hinge, Cam Lift	MKCL134 4-1/2" x 4-1/2"	US32D	MK	087100
1 Entrance Lock	ML2024 NSA	626	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Wall Stop	406	US32D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Threshold	151A		PE	087100

**Set: 41.0**

Doors: [A106](#)

Description: SGL ENTRY FUNCTION INSWING (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Entrance Lock	ML2024 NSA	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 42.0**

Doors: [A140](#)

Description: SGL ENTRY FUNCTION NO CLOSER

3 Hinge, Full Mortise	<a href="#">TA2714 4-1/2" x 4-1/2"</a>	US26D	MK	087100
1 Entrance Lock	<a href="#">ML2024 NSA</a>	626	RU	087100
1 Mortise Cylinder/Core	<a href="#">Match Existing Pyramid LFIC Key System</a>	Match	RU	087100
1 Wall Stop	<a href="#">406</a>	US32D	RO	087100
3 Silencer	<a href="#">608-RKW</a>		RO	087100

**Set: 43.0**

Doors: [A121C](#)

Description: SGL PUSH/PULL (BSP FINISH) WIDE

3 Hinge, Full Mortise, Hvy Wt	<a href="#">T4A3786 5" x 4-1/2"</a>	BSP	MK	087100
1 Pull	<a href="#">RM3101-48 Mtg-Type 12XHD</a>	BSP	RO	087100
1 Push Plate	<a href="#">RM1010</a>	Match	RO	087100
1 Surface Closer	<a href="#">DC8210</a>	BSP	RU	087100
1 Kick Plate	<a href="#">K1050 10" CSK BEV</a>	BSP	RO	087100
1 Wall Stop	<a href="#">406</a>	BSP	RO	087100
1 Gasketing	<a href="#">S773BL</a>		PE	087100

**Set: 44.0**

Doors: [A344](#)

Description: SGL PASSAGE FUNCTION RIM EXIT STC (BLACK FINISH)

3 Hinge, Cam Lift	<a href="#">MKCL134</a>	BSP	MK	087100
1 Rim Exit Device, Passage	<a href="#">ED5200S N910ET</a>	BSP	RU	087100
1 Surface Closer	<a href="#">DC8210</a>	BSP	RU	087100
1 Kick Plate	<a href="#">K1050 10" CSK BEV</a>	BSP	RO	087100
1 Wall Stop	<a href="#">406</a>	BSP	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	<a href="#">PEMKOSTCSET-1A</a>	BL	PE	087100
1 Gasketing	<a href="#">S773BL</a>		PE	087100
1 Threshold	<a href="#">151BSP</a>		PE	087100

**Set: 45.0**

Doors: [A144C](#)

Description: SGL PASSAGE FUNCTION RIM EXIT STC

3 Hinge, Cam Lift	<a href="#">MKCL134</a>	US32D	MK	087100
1 Rim Exit Device, Passage	<a href="#">ED5200S N910ET</a>	630	RU	087100

1 Surface Closer	DC8210	689	RU	087100
1 Kick Plate	K1050 10" BEV CSK	US32D	RO	087100
1 Wall Stop	406	US32D	RO	087100
1 Acoustic Seal Set (Includes Auto Door Bottom)	PEMKOSTCSET-1A	BL	PE	087100
1 Gasketing	S773BL		PE	087100
1 Threshold	151A		PE	087100

**Set: 46.0**

Doors: [A144A](#)

Description: SGL PASSAGE FUNCTION RIM EXIT (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Rim Exit Device, Passage	ED5200S N910ET	BSP	RU	087100
1 Surface Closer	DC8210	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Wall Stop	406	BSP	RO	087100
1 Gasketing	S773BL		PE	087100

**Set: 47.0**

Doors: [A105](#), [A110](#), [A202](#), [A204](#)

Description: SGL PUSH / PULL (BLACK FINISH)

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
1 Deadbolt	DL4117	BSP	RU	087100
1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100
1 Push Plate	RM1010	Match	RO	087100
1 Pull	RM3101-12 Mtg-Type 12XHD	BSP	RO	087100
1 Surface Closer	DC8200	BSP	RU	087100
1 Kick Plate	K1050 10" CSK BEV	BSP	RO	087100
1 Mop Plate	K1050 6" CSK BEV	BSP	RO	087100
1 Wall Stop	406	BSP	RO	087100
3 Silencer	608-RKW		RO	087100

**Set: 48.0**

Doors: [A111B](#), [A135A](#), [A146B](#), [A206B](#), [A208B](#)

Description: PAIR PUSH/PULL (BSP FINISH)

6 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	BSP	MK	087100
2 Pull	RM3101-48 Mtg-Type 12XHD	BSP	RO	087100
2 Push Plate	RM1010	Match	RO	087100
2 Surface Closer	DC8210	BSP	RU	087100

2 Kick Plate	<a href="#">K1050 10" CSK BEV</a>	BSP	RO	087100
2 Wall Stop	<a href="#">406</a>	BSP	RO	087100
1 Astragal	<a href="#">18041BSPNB</a>		PE	087100
1 Gasketing	<a href="#">S773BL</a>		PE	087100

Notes: A111B, A146B, A206B, A208B: OMIT KICK PLATE.

A111B, A146B, A206B, A208B: MOUNT PULLS 7" FROM EDGE OF DOOR.

**Set: 49.0**

Doors: [A103A](#), [A114A](#), [A116A](#), [A116C](#), [A119](#), [A120A](#), [A121B](#), [A124A](#)

Description: OVERHEAD DOOR

2 Rim Cylinder/Core	<a href="#">Match Existing Pyramid LFIC Key System</a>	Match	RU	087100
1 Balance of Hardware	By Assembly Manufacturer		OT	

**Set: 50.0**

Doors: [A205A](#)

Description: SGL CARD READER LOCK OUTSWING WIDE

3 Hinge, Full Mortise, Hvy Wt	<a href="#">T4A3786 5" x 4-1/2"</a>	US26D	MK	087100	
1 Electric Power Transfer	<a href="#">CEPT-10</a>	630	SU	087100	⚡
1 Fail Secure Lock	<a href="#">ML20906-SEC NSA M92</a>	626	RU	087100	⚡
1 Mortise Cylinder/Core	<a href="#">Match Existing Pyramid LFIC Key System</a>	Match	RU	087100	
1 Surface Closer	<a href="#">DC8210</a>	689	RU	087100	
1 Wall Stop	<a href="#">406</a>	US32D	RO	087100	
3 Silencer	<a href="#">608-RKW</a>		RO	087100	
1 ElectroLynx Harness	<a href="#">QC-C2500P</a>		MK	087100	⚡
1 ElectroLynx Harness	<a href="#">QC-C300P</a>		MK	087100	⚡
1 Position Switch	<a href="#">DPS-M-GR</a>		SU	087100	⚡
1 Power Supply	<a href="#">AQD x Amps Required</a>		SU	087100	⚡
1 Card Reader	By Security Contractor		OT		

**Set: 51.0**

Doors: [A142](#)

Description: SGL CARD READER LOCK INSWING WIDE

3 Hinge, Full Mortise, Hvy Wt	<a href="#">T4A3786 5" x 4-1/2"</a>	US26D	MK	087100	
1 Electric Power Transfer	<a href="#">CEPT-10</a>	630	SU	087100	⚡
1 Fail Secure Lock	<a href="#">ML20906-SEC NSA M92</a>	626	RU	087100	⚡

1 Mortise Cylinder/Core	Match Existing Pyramid LFIC Key System	Match	RU	087100	
1 Surface Closer	DC8200	689	RU	087100	
1 Wall Stop	406	US32D	RO	087100	
3 Silencer	608-RKW		RO	087100	
1 ElectroLynx Harness	QC-C2500P		MK	087100	⚡
1 ElectroLynx Harness	QC-C300P		MK	087100	⚡
1 Position Switch	DPS-M-GR		SU	087100	⚡
1 Power Supply	AQD x Amps Required		SU	087100	⚡
1 Card Reader	By Security Contractor		OT		

**Set: 52.0**

Doors: A101M, A101N

Description: OPENING(S) NOT FOUND

1 Openings	Not Found		OT		
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Notes: OPENINGS LISTED IN DOOR SCHEDULE, NOT TAGGED ON FLOOR PLANS.

END OF SECTION 087100

## SECTION 08 71 13

### AUTOMATIC DOOR OPERATORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Low-energy door operators for swinging doors.

##### 1.2 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Double-Egress (Doors): A pair of doors that simultaneously swing, with the two doors moving in opposite directions with no mullion between them.
- D. Double-Swing (Doors): A pair of doors that swing, with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.
- E. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- F. For automatic door terminology, see BHMA A156.19 for definitions of terms.

##### 1.3 COORDINATION

- A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.
- B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.
- C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to the following:
  - 1. Power supplies.
  - 2. Access-control system.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For automatic door operators.
  - 1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
  - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Indicate locations of activation and safety devices.
  - 4. Include diagrams for power, signal, and control wiring.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranties: For manufacturer's special warranties.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Faulty or sporadic operation of automatic door operator, including controls.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
  2. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Horton.
  2. Sargent.
  3. Stanley.
- B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

#### 2.2 AUTOMATIC DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
  2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
  3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load indicated on Drawings.
- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.
- C. Hinges: See Section 08 71 00 "Door Hardware" for hinge type for each door that door operator shall accommodate.
- D. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch- (3.2-mm-) thick, extruded or formed aluminum; manufacturer's standard width; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
- E. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 LOW-ENERGY DOOR OPERATORS FOR SWINGING DOORS

- A. Standard: BHMA A156.19.
- B. Performance Requirements:
  - 1. Opening Force if Power Fails: Not more than 15 lbf (67 N) required to release latch if provided, not more than 30 lbf (133 N) required to manually set door in motion, and not more than 15 lbf (67 N) required to fully open door.
  - 2. Entrapment-Prevention Force: Not more than 15 lbf (67 N) required to prevent stopped door from closing or opening.
- C. Configuration: Operator to control single swinging door.
  - 1. Traffic Pattern: Two way.
  - 2. Operator Mounting: Surface.
- D. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
- E. Operating System: Electromechanical.
- F. Microprocessor Control Unit: Solid-state controller.
- G. Features:
  - 1. Adjustable opening and closing speed.
  - 2. Adjustable opening and closing force.
  - 3. Adjustable backcheck.
  - 4. Adjustable hold-open time from zero to 30 seconds.
  - 5. Adjustable time delay.
  - 6. Adjustable acceleration.
  - 7. Obstruction recycle.
  - 8. On-off/hold-open switch to control electric power to operator.
- H. Activation Device: Push-plate switch on each side of door to activate door operator.
- I. Exposed Finish: Finish matching door and frame.

### 2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Extrusions: ASTM B 221 (ASTM B 221M).
  - 2. Sheet: ASTM B 209 (ASTM B 209M).
- B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

### 2.5 CONTROLS

- A. General: Provide controls, including activation and safety devices, in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
- B. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.
- C. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator.
  - 1. Configuration: Round push plate with 4-by-4-inch (100-by-100-mm) junction box.
    - a. Mounting: Recess mounted, semiflush in wall.
  - 2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
  - 3. Message: International symbol of accessibility and "Push to Open."
- D. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

### 2.6 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.
  - 1. Application Process: Operator manufacturer's standard process.
  - 2. Provide sign materials with instructions for field application when operators are installed.



## 2.7 FABRICATION

- A. Factory fabricate automatic door operators to comply with indicated standards.
- B. Form aluminum shapes before finishing.
- C. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.
- D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary, protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
- C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.
- D. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch (6 mm) and less than 3/4 inch (19 mm) with door in any position.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install automatic door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
  - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
  - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
- B. Controls: Install activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring in accordance with Electrical Engineer's documents.
- C. Access-Control System: Where access control is indicated, connect operators to access-control system.
- D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

### 3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections :
  - 1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

- C. Automatic door operators will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
  - 1. Adjust operators on exterior doors for tight closure.
- B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

**END OF SECTION**

## SECTION 08 80 00

### GLAZING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass products.
  - 2. Insulating glass.
  - 3. Anti-reflective glass.
  - 4. Glazing sealants.
  - 5. Glazing tapes.
  - 6. Miscellaneous glazing materials.

##### 1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

##### 1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Accessory Samples: For sealants, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated Design: Provide shop drawings signed and sealed by a structural engineer licensed to practice in the location of the project, indicating ability of system and attachment to supporting construction to resist indicated or code required loads.

##### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranties: For special warranties.

#### 1.7 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.
- B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Install glazing in mockups specified in Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

#### 1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cardinal Glass Industries.
  - 2. Guardian Industries Corp.
  - 3. Oldcastle BuildingEnvelope.
  - 4. McGrory Glass.
  - 5. Pilkington North America.
  - 6. Vitro.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
  - 1. Design Wind Pressures: As indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
  - 2. Design Snow Loads: As indicated on Drawings.
  - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
  - 4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
  - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  - 4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
  - 5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

### 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
  - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

### 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Reflective-Vision Glass: ASTM C1376.

### 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
  - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Technoform Glass Insulation NA, Inc.
    - b. Thermix; a brand of Ensinger USA.
  - 4. Desiccant: Molecular sieve or silica gel, or a blend of both.

### 2.6 ANTI-REFLECTIVE GLASS

- A. Manufacturers: Subject to compliance with requirements herein, provide products by one of the following:
  - 1. Groglass SIA; Sapphire AR, as distributed by JNS Glass & Coatings, jnsglass.com.
  - 2. McGrory Glass.
  - 3. Schott North America.
  - 4. Tru Vue, Inc.; Tru Vue Classic AR.
- B. Basis-of-Design Product: As indicated on Drawings.
- C. Description: Anti-reflective (AR) glass with dielectric sputter-applied coating on both sides providing a less than 1 percent reflectance from 425 to 650 nanometers with an oil-resistant, anti-fingerprint, oleophobic (anti-smudge) coating on both sides.

- D. Thickness: Minimum 6 mm.
- E. Size: As indicated on Drawings.

## 2.7 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 795.
    - b. GE Advanced Materials - Silicones; Contractors N SCS1800.
    - c. Pecora Corporation; 864.
    - d. Polymeric Systems, Inc.; PSI-641.
    - e. Tremco Incorporated; Spectrem 2.

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  - 1. AAMA 804.3 tape, where indicated.
  - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
  - 1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- D. Spacers:
  - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- E. Edge Blocks:
  - 1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
  - 2. Type recommended in writing by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.



- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

#### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

#### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

#### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

#### 3.7 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.

- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### 3.8 MONOLITHIC GLASS SCHEDULE

- A. Clear, annealed float glass.
  - 1. Minimum Thickness: 6 mm.
- B. Clear, fully tempered float glass.
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.

### 3.9 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Tinted Insulating Glass Type:
  - 1. Basis-of-Design Product: Vitro; Solarban 60 (2) Solargray + Clear.
  - 2. Overall Unit Thickness: 1 inch (25 mm).
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outdoor Lite: Tinted heat-strengthened or fully tempered float glass as recommended by manufacturer or required by code.
  - 5. Tint Color: As selected by Architect from manufacturer's full range.
  - 6. Interspace Content: Air.
  - 7. Indoor Lite: Clear heat-strengthened or fully tempered float glass as recommended by manufacturer or required by code.
  - 8. Low-E Coating: Sputtered on second surface.
  - 9. Winter Nighttime U-Factor: 0.29 maximum.
  - 10. Visible Light Transmittance: 35 percent minimum.
  - 11. SGHC: 0.25 maximum.
  - 12. Safety glazing required.

**END OF SECTION**

## SECTION 08 83 00

### MIRRORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
  - 1. Tempered glass mirrors qualifying as safety glazing in fitness rooms or required by building code.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

##### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

##### 1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
  - 1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

##### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

##### 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
  - 1. Warranty Period: Five years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Binswanger Mirror; a division of Vitro America, Inc.
  - 2. Gardner Glass, Inc.
  - 3. Glasswerks LA, Inc.
  - 4. Guardian Industries Corp..
  - 5. Virginia Mirror Company, Inc.

6. Walker Glass Co., Ltd.
  - B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
  - C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- 2.2 SILVERED FLAT GLASS MIRRORS
- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
  - B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
    1. Nominal Thickness: 6.0 mm .
- 2.3 MISCELLANEOUS MATERIALS
- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
  - B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
  - C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Palmer Products Corporation.
      - b. Pecora Corporation.
- 2.4 MIRROR HARDWARE
- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
    1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
      - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - 1) Andscot Company, Inc.
        - 2) Laurence, C. R. Co., Inc.
        - 3) Stylmark, Inc.
    2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
      - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - 1) Andscot Company, Inc.
        - 2) Laurence, C. R. Co., Inc.
        - 3) Stylmark, Inc.
    3. Finish: Black anodized, unless otherwise indicated.
  - B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
  - C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.
- 2.5 FABRICATION
- A. Fabricate mirrors in the shop to greatest extent possible.
  - B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
  - C. Mirror Edge Treatment: Flat polished.
    1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

#### **3.2 PREPARATION**

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

#### **3.3 INSTALLATION**

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
  1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- B. Provide a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
  1. Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
  2. Install mastic as follows:
    - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
    - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
    - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface.

#### **3.4 CLEANING AND PROTECTION**

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

**END OF SECTION**

**SECTION 08 87 00**  
**GLAZING SURFACE FILMS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes film products applied to glass surfaces.

1.2 DEFINITIONS

- A. Fire Performance: Surface burning characteristics when applied to 1/4 inch, nominal clear glass and tested in accordance with ASTM E84:
  - 1. Flame Spread Index: 25 maximum.
  - 2. Smoke Developed: 50 maximum.

1.3 ACTION SUBMITTALS

- A. Product Data: For each film product indicated.
- B. Samples for Color Selection: Manufacturer's standard sample sets showing the full range of colors available for each type of product indicated.
- C. Samples for Verification: 12-inch square samples of each type of glazing film specified, in color specified.
- D. Shop Drawings: identify location for each type of film indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty: Special warranty specified in this Section.
- B. Maintenance Data and Replacement Instructions: For each type of film overlay to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing systems similar to those indicated for this Project and meeting the standards of the International Standards Organization (ISO), ISO 9001 Quality Assurance in Production and Installation.
- B. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by film manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements.
- C. Source Limitations: Obtain each type of film overlay through one source from a single manufacturer to provide products of consistent quality in appearance and physical properties.
- D. Mockups: Apply glazing films in locations as directed to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
  - 1. Obtain approval of field samples before continuing with remainder of installation.
  - 2. Maintain field samples during remainder of installation in an undisturbed condition as a standard for judging the completed Work.
  - 3. Approved field samples may become part of the completed Work.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
  - 1. Conduct pre-installation conference in conjunction with installation of mockup.
  - 2. Meet with Owner, Architect, glazing film Installer and glazing film manufacturer's representative.
  - 3. Review methods and procedures related to installation, including manufacturer's written instructions.
  - 4. Examine substrate conditions for compliance with requirements.
  - 5. Review temporary protection measures required during and after installation.

6. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store and protect glazing films according to manufacturer's written instructions and as needed to prevent damage, condensation, temperature changes, direct exposure to sun, or other causes.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with film installation when ambient and substrate temperature conditions are outside limits permitted by manufacturer and when glass substrates are wet from frost, condensation, or other causes.

#### 1.9 WARRANTY

- A. Manufacturer's Warranty: Fully executed warranty, written in favor of the Owner, agreeing to replace films that deteriorate as defined in "Definitions" Article, within 5 years from date of original installation.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. 3M.
  2. Avery Dennison Graphics.
  3. CPFilms Inc.; LLumar Films.
  4. FDC Graphic Films, Inc.
  5. Huper Optik.
  6. Solyx , SimGlas.

#### 2.2 DECORATIVE GLAZING SURFACE FILMS

- A. Decorative Film Overlay: Translucent, dimensionally stable, cast PVC film, 2-mil- (0.05-mm-) minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.
  1. Removable release liner.
  2. Pressure sensitive adhesive with integral ultraviolet absorbers.
  3. Clear, dyed, or printed pattern layer of polyester film.
  4. Possible layer of metallized or sputtered polyester film.
  5. Possible scratch resistant coating.
- B. Basis-of-Design Product: As scheduled.
- C. Colors and Patterns: As scheduled.

#### 2.3 ATTACK-RESISTANT GLAZING SURFACE FILMS

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. 3M; Ultra S800.
  2. Hanita Coatings; 11 Mil Clear Safety and Security Film R29805T.
  3. XPEL Security Clear 14 Mil PS XVSC14M.
- B. Basis-of-Design Product: 3M; Ultra S800.
  1. Minimum Performance Characteristics:
    - a. Tensile Strength: 31,500 psi.
    - b. Break Strength: 253 pounds per inch.
    - c. Elongation at Break: 135 percent.
    - d. Abrasion Resistance: Less than five percent.

#### 2.4 GLAZING FILM ACCESSORIES

- A. General: Provide products complying with requirements of glazing film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Adhesive: Pressure Sensitive acrylic adhesive system.
- C. Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine glass and surrounding adjacent surfaces for conditions affecting installation.
  - 1. Report conditions that may adversely effect installation. In report, include description of any glass that is broken, chipped, cracked, abraded, or damaged in any way.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Immediately before beginning installation of films, clean glass surfaces of substances that could impair glazing film's bond, including mold, mildew, oil, grease, dirt and other foreign materials.
- C. Blade the inside surface of window glass with industrial razors to ensure removal of foreign contaminants.
- D. Protect window frames and surrounding surfaces and materials from damage during installation.

#### **3.3 INSTALLATION**

- A. General: Comply with glazing film manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements are indicated.
- B. Install film continuously, but not necessarily in one continuous length. Install with no gaps or overlaps.
- C. If seamed, install with no gaps or overlaps. Install seams vertical and plumb. No horizontal seams allowed.
- D. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
- E. Install film with mounting solution and custom cut to the glass with neat, square comers and edges to within 1/8 inch of the window frame.
- F. Remove air bubbles, wrinkles, blisters, and other defects.
- G. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, banding, thin spots or pinholes.
  - 1. If installed film does not meet this criteria, remove and replace with new film.

#### **3.4 CLEANING**

- A. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
- B. After application of film, wash film using cleaning methods recommended by glazing film manufacturer. Do not use abrasive-type cleaning agents or bristle brushes.
- C. Replace films that cannot be cleaned.

**END OF SECTION**



## SECTION 09 05 61.13

### MOISTURE VAPOR EMISSION CONTROL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

##### 1.2 UNIT PRICES

- A. Work of this Section is affected by Moisture Vapor Emission Control Unit Price.

##### 1.3 DEFINITIONS

- A. MVE: Moisture vapor emission.
- B. MVER: Moisture vapor emission rate.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preinstallation testing reports.
- D. Field quality-control reports.

##### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

##### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

##### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
  - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F (18 deg C) and not more than 85 deg F (29.4 deg C) at least 48 hours before use.
  - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29.4 deg C) and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
  - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F (3 deg C) higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
  - 1. MVER: Maximum 25 lb of water/1000 sq. ft. (11.34 kg of water/92.9 sq. m) when tested according to ASTM F 1869.
  - 2. Relative Humidity: Maximum 100 percent when tested according to ASTM F 2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm (5.75 ng/Pa x s x sq. m) when tested according to ASTM E 96/E 96M.
- C. Tensile Bond Strength: For MVE-control system, greater than 200 psi (1.38 MPa) with failure in the concrete according to ASTM D 7234.

### **2.2 MVE-CONTROL SYSTEM**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. ARDEX Americas; ARDEX MC RAPID One-Coat Moisture Control System For Concrete to Receive ARDEX Underlayments.
  - 2. Floor Seal Technology, Inc.; MES 100.
  - 3. H.B. Fuller Construction Products Inc. / TEC; LiquiDam.
  - 4. KOSTER American Corporation; VAP I 2000 FS.
  - 5. LATICRETE SUPERCAP, LLC; LATICRETE SUPECAP Moisture Vapor Control.
  - 6. MAPEI Corporation; Planseal VS.
  - 7. Synthetics International; Synthetic30.
  - 8. USG Corporation; USG Durock Brand RH-100 Moisture Vapor Reducer.
- B. MVE-Control System: ASTM F 3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
  - 1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
  - 2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

### **2.3 ACCESSORIES**

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi (20.68-MPa) compressive strength after 28 days when tested according to ASTM C 109/C 109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's hydraulic cement-based underlayment.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of system indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Preinstallation Testing:
  - 1. Testing Agency: Engage a qualified testing agency to perform tests.

2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
  3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Internal Relative Humidity Test: Using in situ probes, ASTM F 2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
  4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. (9.29-sq. m) area of MVE-control system to prepared concrete substrate and test according to ASTM D 7234.
    - a. Proceed with installation only where tensile bond strength is greater than 200 psi (1.38 MPa) with failure in the concrete.
- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
  2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
  3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
  4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
  5. Fill surface depressions and irregularities with patching and leveling material.
  6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
  7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
  8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.
- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

### 3.3 INSTALLATION

- A. General: Install MVE-control system according to ASTM F 3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
  1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
  1. Verify that surface preparation meets requirements.
  2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.

3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.
- 3.5 PROTECTION
- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
  - B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

**END OF SECTION**

## SECTION 09 21 16.23

### GYPSUM BOARD SHAFT WALL ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes gypsum board shaft wall assemblies.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.
- B. Span and Deflection Design Criteria: Provide height to load deflection charts showing studs supplied conform to deflection limit scheduled and allowed per ASTM C 754.
  - 1. Mark on chart(s) showing major partitions scheduled conformance with criteria.
  - 2. Submit manufacturer's certification of stud size, thickness, and spacing complying with performance requirements and selections made by architect are correct for application shown.

##### 1.3 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or a similar organization that provides a verifiable code compliance program

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.
- B. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202 "Code of Standard Practice."

##### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members" and ASTM C645, Section 10, unless otherwise indicated.

##### 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.

- C. Gypsum Shaftliner Board:
1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch (25.4 mm) thick, with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) American Gypsum; 1-inch Shaft Liner Gypsum.
      - 2) CertainTeed Corporation; Shaftliner Type X.
      - 3) Continental Building Products, LLC; Fire-Resistant Shaftliner Type X.
      - 4) Georgia-Pacific Building Products; ToughRock Shaftliner.
      - 5) LaFarge; Shaftliner Type X.
      - 6) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
      - 7) PABCO Gypsum; Pabcore Shaftliner Type X.
      - 8) United States Gypsum Company; SheetRock Gypsum Liner Panels.
  2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) American Gypsum; M-Bloc 1 inch Shaft Liner with Mold & Moisture Resistance.
      - 2) CertainTeed Corporation; M2 Tech Shaftliner Type X.
      - 3) Continental Building Products, LLC; Mold Defense Shaftliner Type X.
      - 4) Georgia-Pacific Building Products; DensGlass Shaftliner.
      - 5) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
      - 6) PABCO Gypsum; Pabcore Mold Curb Plus Shaftliner Mold & Water Resistant, Type X.
      - 7) United States Gypsum Company; Sheetrock Brand Mold Tough Gypsum Liner Panel.
  3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C 1658/C 1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) American Gypsum; M-Glass Shaft Liner with Mold and Moisture Resistance.
      - 2) Continental Building Products, LLC; Weather Defense Platinum Shaftliner Type X.
      - 3) Georgia-Pacific Building Products; Dens-Glass Shaftliner Shaftwall/Stairwell Systems.
      - 4) National Gypsum Company; Gold Bond Brand eXP Shaftliner.
      - 5) United States Gypsum Company; Sheetrock Glass-Mat Liner Panel Mold Tough.
- D. Non-Load-Bearing Steel Framing, General: Complying with AISI S220 ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
1. Shaftwall and Stairwall Systems:
    - a. Products: Subject to compliance with requirements, provide the following:
      - 1) ClarkDietrich; Shaftwall and Stairwall Systems.
  2. Corridor Ceiling System:
    - a. Products: Subject to compliance with requirements, by the following:
      - 1) ClarkDietrich; Corridor Ceiling System.
  3. ClarkDietrich; Shaftwall and Stairwall Systems. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120) unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
1. Depth: As required by performance requirements for horizontal deflection.
  2. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
1. Minimum Base-Metal Thickness: Matching steel studs.
- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Clark Dietrich Blazeframe DSL Max Track.

- b. CEMCO; California Expanded Metal Products Co; FAS Track.
  - c. Fire Trak Corp; Fire Track System.
  - d. Metal-Lite; The System.
  - e. Steel Network, Inc. (The); VertiTrack VTD.
- H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than 0.033 inch (0.84 mm) thick.
  - I. Finish Panels: Gypsum board as specified in Section 09 29 00 "Gypsum Board."
  - J. Sound Attenuation Blankets: As specified in Section 09 81 16 "Acoustical Blanket Insulation."

### 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  - 1. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated).
- F. Acoustical Sealant: Section 07 92 19 "Acoustical Joint Sealants."
- G. Gypsum Board Cants:
  - 1. Gypsum Board Panels: As specified in Section 09 29 00 "Gypsum Board," Type X, 1/2- or 5/8-inch (13- or 16-mm) panels.
  - 2. Adhesive: Laminating adhesive as specified in Section 09 29 00 "Gypsum Board."
  - 3. Non-Load-Bearing Steel Framing: As specified in Section 09 22 16 "Non-Structural Metal Framing."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 07 81 00 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
  - C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
    - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
    - 2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
  - D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
  - E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
  - F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
  - H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
  - I. Gypsum Board Cants: At projections into shaft exceeding 4 inches (102 mm), install gypsum board cants covering tops of projections.
    - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft wall framing.
    - 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft wall framing.
  - J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- 3.4 PROTECTION
- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
  - B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
    - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
    - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION**



## SECTION 09 22 16

### NON-STRUCTURAL METAL FRAMING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Framing systems.
  - 2. Suspension systems.
  - 3. Grid suspension systems.
- B. Related Requirements:
  - 1. Section 05 40 00 "Cold-Formed Metal Framing" for interior non-load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Framing systems.
  - 2. Suspension systems.
  - 3. Grid suspension systems.
- B. Span and Deflection Design Criteria: Provide height to load deflection charts showing studs supplied conform to deflection limit scheduled and allowed per ASTM C 754.
  - 1. Mark on chart(s) showing all major partitions scheduled conformance with criteria.
  - 2. Submit manufacturer's certification of stud size, thickness, and spacing complying with performance requirements and selections made by architect are correct for application shown.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

##### 1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or be a part of a similar organization that provides verifiable code compliance program.

##### 1.5 SEQUENCING

- A. Coordinate placement of concealed internal wall reinforcement, such as backing plates, for items to be attached to metal support systems.

##### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members" and ASTM C645, Section 10, if applicable to local code, unless otherwise indicated.
- B. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.
- C. Horizontal Deflection:
  - 1. Minimum Base Steel Thickness: 0.0179-inch (25 gauge) unless indicated otherwise on Drawings or below.
  - 2. Interior Metal Stud/Gypsum Board Assemblies, Typical Locations: Withstand lateral loading (air pressure) of 5 psf with deflection limit not more than L/240 of partition height.
  - 3. Interior Metal Stud/Gypsum Board Assemblies at Atriums, Lobbies, Service Corridors, Exit Corridors, Elevator Lobbies, Vertical Shafts, and walls receiving plaster veneer: Withstand lateral loading (air pressure) of 7.5 psf with deflection limit not more than L/360 of partition height.
  - 4. Interior Metal Stud/Gypsum Board Assemblies at Locations with Ceramic Tile or Other Hard Surface Finishes: Withstand typical lateral loading (air pressure) with deflection limit not more than L/360 of partition height, minimum 0.0329-inch (20 gauge) studs at 16 inches on center.
  - 5. Where wall mounted equipment, woodwork, and casework items are indicated or elsewhere as shown on Drawings, provide minimum 0.0568-inch (16 gage) studs.
  - 6. At jambs of openings provide two minimum 0.0329 inch (20 gage) studs.
  - 7. Ceilings: At ceilings using mold-mildew resistant gypsum framing to be 16 inches o.c. for 5/8 inch gypsum.
  - 8. Refer to Division 05 for stud framing which is exposed to wind loads and for studs carrying heavy vertical loads, such as, cement plaster, manufactured stone masonry, stone tile thicker than 3/4 inch, etc.
- D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- E. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.

### 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
  - 1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvanized products are unacceptable.
    - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
    - b. Coating roll-formed from steel complying with mechanical and chemical requirements of ASTM A1003 with a zinc-based coating.
    - c. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction
- B. Studs and Track: AISI S220 and ASTM C645, Section 10.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CEMCO.
    - b. ClarkDietrich
    - c. Custom Stud, Inc.
    - d. MarinoWARE.
    - e. MBA Building Supplies.
    - f. MRI Steel Framing, LLC.
    - g. SCAFCO Steel Stud Company.
    - h. Steel Network, Inc. (The).
    - i. Telling Industries.

2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
  3. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) CEMCO.
      - 2) ClarkDietrich.
      - 3) MarinoWARE.
      - 4) MBA Building Supplies.
      - 5) Metal-Lite.
      - 6) SCAFCO Steel Stud Company.
      - 7) Steel Network, Inc. (The).
      - 8) Telling Industries.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CEMCO.
    - b. ClarkDietrich.
    - c. Fire Trak Corp.
    - d. MarinoWARE.
    - e. Metal-Lite.
    - f. SCAFCO Steel Stud Company.
    - g. Steel Network, Inc. (The).
- E. Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).
  2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  3. Basis-of-Design Product: ClarkDietrich; Backer Bar and Notched Track.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  2. Depth: As indicated on Drawings.
  3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  2. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).
  3. Depth: 7/8 inch (22.2 mm).

- H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company.
  - 2. Configuration: Asymmetrical.
- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: As indicated on Drawings.
  - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
  - 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- J. Partial Wall Framing Connection: Connector designed to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track.
  - 1. Minimum Base-Steel Thickness: 0.0966 inch (2.45 mm).
  - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. MRI Steel Framing, LLC.
    - d. SCAFCO Steel Stud Company
  - 3. Basis-of-Design Product: ClarkDietrich; Pony Wall.

### 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
    - a. Uses: Securing hangers to structure.
    - b. Type: Torque-controlled, expansion anchor.
    - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
    - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
  - 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
  - 1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
  - 2. Steel Studs and Tracks: AISI S220 and ASTM C645, Section 10.
    - a. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).
    - b. Depth: As indicated on Drawings.
    - c. Basis-of-Design Product: ClarkDietrich; ProSTUD Drywall Framing System with Smart Edge Technology.
  - 3. Hat-Shaped, Rigid Furring Channels: 7/8 inch (22 mm) deep.
    - a. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).

- b. Basis-of-Design Product: ClarkDietrich; Hat-Shaped, Rigid Furring Channels.
- 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
  - a. Configuration: Asymmetrical.
  - b. Basis-of Design Product: ClarkDietrich; RC Deluxe (RCSD).

#### 2.4 GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Armstrong World Industries, Inc.; Drywall Grid System.
    - b. Rockfon; Chicago Metallic Drywall Grid System.
    - c. United States Gypsum Company; Drywall Suspension System.

#### 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
  - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
  - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

#### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.

- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
  - 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
  - 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

### 3.5 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches (1219 mm) o.c.
  - 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
  - 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 5. Do not attach hangers to steel roof deck.
  - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

### 3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

### 3.7 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

**END OF SECTION**

## SECTION 09 29 00

### GYPSUM BOARD

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Tile backing panels.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.3 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Build mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
  - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  - 3. Simulate finished lighting conditions for review of mockups.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

##### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

##### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

##### 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.



- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. American Gypsum; 5/8 inch FireBloc Type X Gypsum Wallboard.
      - b. CertainTeed Corporation; Type X Gypsum Board.
      - c. Continental Building Products, LLC; Firecheck Type X.
      - d. Georgia-Pacific Building Products; ToughRock Fireguard X Gypsum Board.
      - e. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board.
      - f. PABCO Gypsum; Flame Curb Type X.
      - g. United States Gypsum Company; USG Sheetrock Brand Firecode X Gypsum Panels.
    - 2. Thickness: 5/8 inch (15.9 mm).
    - 3. Long Edges: Tapered.
  - C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. American Gypsum; 1/2" Interior Ceiling Board.
      - b. CertainTeed Corporation; Interior Ceiling Gypsum Board.
      - c. Continental Building Products, LLC; Sagcheck.
      - d. Georgia-Pacific Building Products; ToughRock Span 24 Ceiling Board.
      - e. PABCO Gypsum; Interior Ceiling Sag-Resistant Ceiling Panel.
      - f. United States Gypsum Company; Imperial Sag-Resistant Interior Ceiling Gypsum Base.
    - 2. Thickness: 1/2 inch (12.7 mm).
    - 3. Long Edges: Tapered.
  - D. Impact-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. American Gypsum.
      - b. CertainTeed Corporation.
      - c. Continental Building Products.
      - d. Georgia-Pacific Building Products.
      - e. National Gypsum Company.
      - f. PABCO Gypsum.
      - g. United States Gypsum Company.
    - 2. Core: 5/8 inch (15.9 mm), Type X.
    - 3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
    - 4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
    - 5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
    - 6. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements according to test in Annex A1.
    - 7. Long Edges: Tapered.
    - 8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
  - E. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. American Gypsum ;5/8" M-Bloc Type X with Mold & Moisture Resistance.
      - b. CertainTeed Corporation; M2Tech, Type X.
      - c. Continental Building Products, LLC; Mold Defense, Type X.
      - d. Georgia-Pacific Building Products; ToughRock Mold-Guard.
      - e. National Gypsum Company; Gold Bond Brand XP Fire-Shield.
      - f. PABCO Gypsum; Mold Curb Plus, Type X.
      - g. United States Gypsum Company; USG Sheetrock Brand Mold Tough® Gypsum Panels, Type X.
    - 2. Core:5/8 inch (15.9 mm), Type X.
    - 3. Long Edges: Tapered.
    - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 2.4 SPECIALTY GYPSUM BOARD
- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
    - 1. Products: Subject to compliance with requirements, provide one of the following:
      - a. American Gypsum ; 1/2" FireBloc Type C Gypsum Wallboard.

- b. CertainTeed Corporation; Type C Gypsum Board.
        - c. Continental Building Products, LLC Firecheck Type C.
        - d. Georgia-Pacific Building Products ToughRock Fireguard C.
        - e. National Gypsum Company; Gold Bond Fire-Shield C.
        - f. PABCO Gypsum; Flame Curb Type Super C.
        - g. United States Gypsum Company; USG Imperial Gypsum Base, Firecode C.
      2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
      3. Long Edges: Tapered.
    - B. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
      1. Products: Subject to compliance with requirements, provide one of the following:
        - a. Continental Building Products, LLC; Weather Defense Platinum Interior Type X.
        - b. Georgia-Pacific Building Products; DensArmour Plus.
        - c. National Gypsum Company; eXP Interior Extreme.
        - d. United States Gypsum Company; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
      2. Core: 5/8 inch (15.9 mm), Type X.
      3. Long Edges: Tapered.
      4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 2.5 TILE BACKING PANELS
- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
    1. Products: Subject to compliance with requirements, provide one of the following:
      - a. CertainTeed Corp.; GlasRoc Tile Backer.
      - b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
      - c. National Gypsum; eXP Tile Backer.
      - d. United States Gypsum Company; USG Durock Glass-Mat Tile Backerboard.
    2. Core: 5/8 inch (15.9 mm), Type X.
    3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 2.6 TRIM ACCESSORIES
- A. Interior Trim: ASTM C 1047.
    1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
    2. Shapes:
      - a. Cornerbead.
      - b. Bullnose bead.
      - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      - d. L-Bead: L-shaped; exposed long flange receives joint compound.
      - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      - f. Expansion (control) joint.
  - B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Fry Reglet Corp.
      - b. Gordon, Inc.
      - c. Pittcon Industries.
    2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
    3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
- 2.7 JOINT TREATMENT MATERIALS
- A. General: Comply with ASTM C 475/C 475M.
  - B. Joint Tape:
    1. Interior Gypsum Board: Paper.
    2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
    3. Tile Backing Panels: As recommended by panel manufacturer.

- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
  - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Electrical Box Pads: Putty Pads: Moldable non-curing one component, intumescent, fire-rated material for through-penetration fire stop systems and sound attenuation systems; self-adhering; 1/8-inch thick minimum.
- E. Acoustical Sealant: Refer to Section 07 92 19 "Acoustical Joint Sealants."
- F. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ELECTRICAL BOX PADS FOR SMOKE / FIRE-RATED WALLS

- A. Prior to installing wallboards, install electrical box pads in accordance with manufacturer's written instructions.
- B. Overlap front edge of box so that pad will be compressed around edges of box as gypsum panels are installed.

### 3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.

- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.4 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: Vertical surfaces unless otherwise indicated.
  - 2. Ceiling Type: Ceiling surfaces except at fire rated ceilings, then use Type X.
  - 3. Impact-Resistant Type: As indicated on Drawings.
  - 4. Mold-Resistant Type: As indicated on Drawings.
  - 5. Glass-Mat Interior Type: As indicated on Drawings and the following.
    - a. Interior side of exterior walls.
    - b. Interior partitions where Contractor chooses to install gypsum board prior to building dry-in.
    - c. On tile walls, unless noted otherwise.
    - d. At urinal and toilet fixtures as indicated on Drawings.
  - 6. Tile Backer, Glass-Mat Type:
    - a. Walls in toilet room with shower.
    - b. Tiled walls in showers and bathtubs.
    - c. Tiled walls in toilet rooms and kitchens.
    - d. Behind prefabricated shower or bathtub units.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
  - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
  - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
  - 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

### 3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
  - 1. Do not install screws within 6 inches of the shower wall base so as to not penetrate shower pan waterproofing.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners unless otherwise indicated.
  - 2. Bullnose Bead: Use where indicated.
  - 3. LC-Bead: Use at exposed panel edges.
  - 4. L-Bead: Use where indicated.
  - 5. U-Bead: Use where indicated.
- D. Aluminum Trim: Install in locations indicated on Drawings.

### 3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Where indicated on Drawings.
  - 3. Level 3: Where indicated on Drawings.
  - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

### 3.8 RATED PARTITION IDENTIFICATION

- A. At fire-rated wall and smoke partition assemblies, provide an identification of wall rating in 4-inch high stenciled block letters in red paint. Space identifications 12 feet on center maximum, 4 feet from corners maximum, above ceiling. Provide identification on both sides of wall.
- B. Partition Identification Text: Apply the following, as applicable:
  - 1. WARNING: SMOKE PARTITION – PROPERLY SEAL ALL OPENINGS.
  - 2. WARNING: 1-HOUR SMOKE BARRIER – PROPERLY SEAL ALL OPENINGS.
  - 3. WARNING: 1-HOUR FIRE PARTITION – PROPERLY SEAL ALL OPENINGS.
  - 4. WARNING: 1-HOUR FIRE BARRIER – PROPERLY SEAL ALL OPENINGS.
  - 5. WARNING: 2-HOUR FIRE WALL – PROPERLY SEAL ALL OPENINGS.
  - 6. WARNING: 2-HOUR FIRE BARRIER – PROPERLY SEAL ALL OPENINGS.
- C. Refer to Section 09 91 23 "Interior Painting" for painting requirements.
  - 1. Use interior semi-gloss, latex, low VOC paint.

### 3.9 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before installing gypsum board ceilings, conduct an above-ceiling inspection, and report and correct deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
  - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for Contractor's above-ceiling inspection. Provide Architect with copy of deficiencies report. Architect reserves the right to supplement Contractor's deficiency report with other incomplete or incorrect items that might be observed during Architect's site visit.
  - 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
    - a. Installation of 80 percent of lighting fixtures, powered for operation.
    - b. Installation, insulation, and leak and pressure testing of water piping systems.
    - c. Installation of air-duct systems.
    - d. Installation of air devices.
    - e. Installation of mechanical system control-air tubing.
    - f. Installation of ceiling support framing.
    - g. Touch-up/patching of spray fire-resistive materials (SFRM).
    - h. Installation of penetration firestopping in fire- and smoke-rated partitions.
    - i. Installation of fire-resistant joint sealants in fire-rated partitions.
    - j. Installation of acoustical sealants at adjacent sound-rated partitions.
    - k. Application of fire- and smoke-rated partition identification.

### 3.10 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**END OF SECTION**

## SECTION 09 30 13

### CERAMIC TILING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Porcelain tile.
  - 2. Glazed wall tile.
  - 3. Waterproof membrane for thinset applications.
  - 4. Crack isolation membrane.
  - 5. Metal edge strips.

##### 1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, ANSI A108.17, and ANSI A108.19 which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.
- E. Large format gauged porcelain tiles are 8 mm or less in thickness, and having a face dimension up to 60 inches wide and 118 inches long.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
  - 1. Full-size units of each type and composition of tile and for each color and finish required.
  - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
  - 3. Full-size units of each type of trim and accessory for each color and finish required.
  - 4. Metal edge strips in 6-inch (150-mm) lengths.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
  - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
  - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
  - 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
  - 4. the U.S. Department of Labor as Journeyman Tile Layers.
  - 5. Installer of large format gauged porcelain tile panels shall have completed advanced certification training (ACT)
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of each type of floor tile installation.
  - 2. Build mockup of each type of wall tile installation.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

#### 1.10 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of tile system that fail in materials or workmanship within specified warranty period, when the products are installed within their shelf life and according to governmental regulations and manufacturer's written materials which are in effect at the time installation.
  - 1. Warranty Period: Ten years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
  - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
  - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.



2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Waterproof membrane.
  2. Crack isolation membrane.
  3. Metal edge strips.

## 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 (and A137.3 for large format tiles) for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Dynamic Coefficient of Friction (level interior tiles that will be walked on when wet) per ANSI A137.1: DCOF (Dynamic Coefficient of Friction) of 0.42, DCOF, per DCOF AcuTestSM method.
- F. Large format gauged porcelain tiles shall meet material and installation standards of ANSI A137.3 Standard Specifications for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs.

## 2.3 TILE PRODUCTS

- A. As Scheduled.

## 2.4 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Noble Company (The);Nobleseal TS.
  2. Nominal Thickness: 0.030 inch (0.76 mm), minimum.
- C. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.2-mm) nominal thickness.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Schluter Systems L.P; KERDI.
- D. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    - b. H.B. Fuller Construction Products Inc. / TEC; Hydrflex Waterproofing Crack Isolation Membrane with Waterproofing Mesh.
    - c. LATICRETE SUPERCAP, LLC; Laticrete 9235 Waterproof Membrane.
    - d. MAPEI Corporation; Fiberglass Mesh with Mapelastastic Waterstop.

## 2.5 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch (0.76-mm) nominal thickness.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Noble Company (The); Nobleseal CIS.
    - b. Mapei Corporation Mapeguard 2,
- C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    - b. H.B. Fuller Construction Products Inc. / TEC; Hydraflex Waterproofing Crack Isolation Membrane.
    - c. LATICRETE SUPERCAP, LLC; Laticrete 9235 Waterproof Membrane.
    - d. MAPEI Corporation; Mapelastic CI.

## 2.6 SETTING MATERIALS

- A. Medium-Bed (Large and Heavy Tile), Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4, A118.11, and ISO13007 C2TES1P1. Provide product that is approved by manufacturer for application thickness of 5/8 inch (16 mm).
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; Marble, Granite & Travertine Premium Medium Bed Mortar.
    - b. H.B. Fuller Construction Products Inc. / TEC TEC Ultimate Large Tile Mortar TA 382 / 383.
    - c. LATICRETE SUPERCAP, LLC; 4-XLT.
    - d. MAPEI Corporation; Ultraflex LFT.
- B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15, A118.11, and ISO 13007 C2ES1P1.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Custom Building Products; Megaflex Crack Prevention Mortar.
    - b. H.B. Fuller Construction Products Inc. / TEC; Ultimate 6 Plus Mortar
    - c. LATICRETE SUPERCAP, LLC; LATICRETE® SUPERCAP™ Moisture Vapor Control.
    - d. MAPEI Corporation; Floor Tile Mortar.
  - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

## 2.7 GROUT MATERIALS

- A. High-Performance Tile Grout: ANSI A118.7 and ISO 13007 CG2FAW.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; Prism Color Consistent Grout.
    - b. H.B. Fuller Construction Products Inc. / TEC; TEC Power Grout.
    - c. LATICRETE SUPERCAP, LLC; Permacolor.
    - d. MAPEI Corporation; Ultracolor Plus.
  - 2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; CEG Lite 100% Solids Commercial Epoxy Grout.
    - b. H.B. Fuller Construction Products Inc. / TEC; AccuColor EFX Epoxy Special Effects Grout.
    - c. LATICRETE SUPERCAP, LLC; SpectraLOCK Pro Premium.
    - d. MAPEI Corporation; Kerapoxy CQ.
  - 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.
- C. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

## 2.8 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; with exposed-edge material.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
  - 2. Basis-of-Design Products: As scheduled.
  - 3. Material and Finish: As scheduled.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout as approved by grout manufacturer.

## 2.9 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
    - b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
    - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Glazed Wall Tile: 1/16 inch (1.6 mm) unless scheduled otherwise.
  - 2. Porcelain Tile: 1/4 inch (6.4 mm) unless scheduled otherwise.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- K. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

### 3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

### 3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
  - 1. Remove grout residue from tile as soon as possible.
  - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

### 3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
  - 1. Ceramic Tile Installation: TCNA F113; thinset mortar.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Improved modified dry-set mortar.
    - c. Grout: High-performance sanded grout.
  - 2. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Improved modified dry-set mortar.
    - c. Grout: Water-cleanable epoxy grout.
  - 3. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Improved modified dry-set mortar.
    - c. Grout: High-performance sanded grout.
  - 4. Ceramic Tile Installation: TCNA F125-Full; thinset mortar on crack isolation membrane.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Medium-bed, modified dry-set mortar.
    - c. Grout: High-performance sanded grout.
- B. Interior Wall Installations, Masonry or Concrete:
  - 1. Ceramic Tile Installation: TCNA W202; thinset mortar.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Improved modified dry-set mortar.
    - c. Grout: High-performance unsanded grout.
- C. Interior Wall Installations, Wood or Metal Studs or Furring:
  - 1. Ceramic Tile Installation: TCNA W243; thinset mortar on gypsum board.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Improved modified dry-set mortar.
    - c. Grout: High-performance unsanded grout.
  - 2. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
    - a. Ceramic Tile Type: As scheduled.
    - b. Thinset Mortar: Improved modified dry-set mortar.
    - c. Grout: High-performance unsanded grout.
  - 3. Large Format Gauged Porcelain Tile Panels:
    - a. Mortar: Medium bed modified dry-set mortar.
    - b. Grout: High-performance unsanded grout.

**END OF SECTION**

## SECTION 09 51 13

### ACOUSTICAL PANEL CEILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
  - 1. Acoustical Panels: Samples of each type, color, pattern, and texture in manufacturer's standard sample size, minimum 6 inches square.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension-system members.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Method of attaching hangers to building structure.
    - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  - 5. Size and location of initial access modules for acoustical panels.
  - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    - a. Lighting fixtures.
    - b. Diffusers.
    - c. Grilles.
    - d. Speakers.
    - e. Sprinklers.
    - f. Access panels.
    - g. Perimeter moldings.
  - 7. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
  - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A according to ASTM E 1264.
  - 2. Smoke-Developed Index: 450 or less.

#### 2.3 ACOUSTICAL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. Rockfon (Roxul, Inc.)
  - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. APC-01:
  - 1. Basis-of-Design Product: Armstrong World Industries, Inc.; Ultima High NRC.
  - 2. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
    - a. Type and Form: Type A5; Form 2, water felted.
    - b. Pattern: CE (perforated, small holes and lightly textured).
  - 3. Color: As scheduled.
  - 4. LR: Not less than 0.88.
  - 5. NRC: Not less than 0.65.
  - 6. CAC: Not less than 35.
  - 7. Edge/Joint Detail: Square.
  - 8. Thickness: Manufacturer's standard.

9. Modular Size: As scheduled.
10. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

D. APC-02:

1. Basis-of-Design Product: Armstrong World Industries, Inc.; Ultima.
2. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - a. Type and Form: Type A5; Form 2, water felted.
  - b. Pattern: CE (perforated, small holes and lightly textured).
3. Color: As scheduled.
4. LR: Not less than 0.88.
5. NRC: Not less than 0.60.
6. CAC: Not less than 35.
7. Edge/Joint Detail: Square.
8. Thickness: Manufacturer's standard.
9. Modular Size: As scheduled.
10. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

E. APC-03:

1. Basis-of-Design Product: Armstrong World Industries, Inc.; Backstage Noir.
2. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - a. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted.
  - b. Pattern: E (lightly textured).
3. Color: As scheduled.
4. NRC: Not less than 0.75.
5. CAC: Not less than 30.
6. Edge/Joint Detail: Square.
7. Thickness: 3/4 inch.
8. Modular Size: As scheduled.
9. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Armstrong World Industries, Inc.
  2. CertainTeed Corp.
  3. Chicago Metallic Corporation.
  4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
  1. Structural Classification: Intermediate -duty system.
  2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  3. Face Design: Flat, flush.
  4. Cap Material: Cold-rolled steel or aluminum.
  5. Cap Finish: As selected by Architect from manufacturer's full range.



## 2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.
- C. Hold-Down Clips: Manufacturer's standard hold-down.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corporation.
  - 3. Chicago Metallic Corporation.
  - 4. Fry Reglet Corporation.
  - 5. Gordon, Inc.
  - 6. United States Gypsum Company.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
  - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
  - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
  - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 7. Do not attach hangers to steel deck tabs.
  - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
  - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  - 1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
  - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  - 6. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
    - a. Hold-Down Clips: Space 24 inches (610 mm) o.c. on all cross runners.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**END OF SECTION**

## SECTION 09 54 26

### LINEAR WOOD CEILING PANELS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Concealed suspension system for Wood Grille ceiling panels.
  - 2. Wood Grille ceiling panels for concealed suspension system.
  - 3. Trim and accessories.

##### 1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer, approved by wood ceiling manufacturer, who has completed panel ceilings similar in species, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Inspection: All work must pass inspection and approval of architect, as well as the local codes and regulations or authorities having jurisdiction.
- C. Single-Source Responsibility for Wood Ceiling Panel System: Obtain each type of Wood Grille panels from a single fabricator, with in-house Shop Drawing capabilities, in-house assembly and finishing capabilities, and with resources to provide products of consistent quality in appearance and physical properties without delaying the project.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying project.
- E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Meetings."
- F. Ceiling Panel Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup as directed by architect.
  - 2. Build mockups of typical linear wood ceiling panels in sizes approximately 48 inches long by 72 inches high by full thickness, including backup ceiling materials and accessories.
    - a. Include a typical steel plate and panel joint.
    - b. Include adjacent mock-up of wood paneling.
    - c. Include suspended ceiling grid and acoustical ceiling panel.
  - 3. Approval of mockups is for proper alignment of adjacent surfaces, material finish and edge treatment.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect, in writing.
  - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples: For verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the range of variations expected.
  - 1. 12 by 18 inches samples of each panel type, pattern, and color.

#### 1.4 SHOP DRAWINGS AND COORDINATION WITH OTHER TRADES

- A. Shop Drawings: Provide Shop Drawings/Coordination Drawings for all ceilings, which should include RCP and product details. Coordinate Wood Grille ceiling panel layout and installation of wood panels and suspension system components with other construction elements that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, partition assemblies and all perimeter conditions.

#### 1.5 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install wood panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is completed, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Unloading: Coordinate crate sizes, weights, unloading options, and delivery schedule with manufacturer prior to fabrication. Deliver wood panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other mistreatment.
- B. Acclimatization: Before installing wood panels, permit them to reach room temperature and a stabilized moisture content (at least 72 hours) per AWI standards.
- C. Handling: Handle Wood Grille ceiling panels carefully to avoid chipping edges or damaging units in any way.
- D. Protection:
  - 1. Personnel: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate protective equipment as needed. Read related literature for important information on products before installation. Contractor to be solely responsible for all personal safety issues during and subsequent to installation; architect, specifier, owner, and manufacturer will rely on contractor's performance in such regard.
  - 2. Existing completed work: Protect completed work above suspension system from damage during installation of suspension system components.

#### 1.7 EXTRA MATERIALS

- A. Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
  - 1. Wood Grille ceiling panels: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
  - 2. Suspension System Components: Furnish quantity of each component equal to 2.0 percent of amount installed.

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire Performance Characteristics: Suspended wood ceilings shall conform to Class 1, or A flame spread rating, tested according to ASTM E 84; Flame Spread: 25 or less. Smoke Developed: 450 or less.

#### 2.2 WOOD GRILLE CEILING PANELS AND SUSPENSION SYSTEM

- A. General: The following manufacturer is basis of design:
  - 1. Armstrong World Industries, Inc.

#### 2.3 WOOD GRILLE CEILING PANELS

- A. Basis-of-Design Product: As scheduled.
  - 1. Wood Panels: Provided in random lengths with tongue and groove ends or in fixed lengths, as indicated.
    - a. Size: As indicated.
    - b. Trim and Border Treatment: Provide end caps or junction trims as indicated.
    - c. Finish: As scheduled.

## 2.4 ACCESSORIES

- A. Cliprail: Attachment clips are spring-steel with phosphate pre-treatment and corrosion-resistant coating and are attached at pre-spaced intervals to heavy-duty grid.
- B. C-Hangers: Suspension hangers that are direct-screwed to the panel and hang over the heavy-duty-grid. Hangers are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.
- C. Torsion Springs and Saddle Clips: Two parts of a suspension system in which the torsion spring is direct-screwed to the panel and compressed to attach to the saddle clip that is fitted over the heavy-duty-grid. Springs and clips are made of spring-steel with phosphate pre-treatment and corrosion-resistant coating.

## 2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal T-Grid Suspension System: Provide standard interior Metal Heavy Duty 15/16-inch suspension T-Grid system using Main Runners, Cross-tees, Wall Angle or Shadow Moldings of types, structural classifications, and black finishes indicated and that comply with applicable ASTM C 635 requirements. Comply with all applicable codes and ordinances.
- B. Attachment Devices: Size for 3 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire, Braces, Ties, Hanger Rods, Flat Hangers and Angle Hangers: Provide wires, rods and hangers that comply with applicable ASTM specifications.

## 2.6 FABRICATION

- A. Edges, borders, and perimeter trims shall be indicated on the Drawings in accordance with the manufacturer's standard design details. Suspended wood ceiling products specified shall be supplied by the wood slat ceiling manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. General: Examine substrates and structural framing to which ceiling panels attach or abut, with installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Layout: Measure each ceiling area and establish the layout of Wood Grille Panel to balance border widths at opposite edges. Avoid using less-than-half-width panels at borders, and conform to the layout shown on drawings in accordance with approved Shop Drawings.

### 3.3 INSTALLATION

- A. General: Install linear wood ceiling panels to comply with manufacturer's instructions and CISCA "Ceiling Systems Handbook."
- B. Attachments: Suspend ceiling hangers from building's structural members per manufacturer's instructions and in compliance with all local codes and regulations.
- C. Installation of Metal T-Bar Grid: Install, align, brace, tie-off, mount, handle interferences, and space suspension T-Grid in accordance with suspension manufacturer's instructions and in compliance with all local codes and regulations.
- D. Installation of Wood Grille: Install Wood Grille ceiling panels in accordance with manufacturer's installation instructions and in compliance with all local codes and regulations. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit, as required.
- E. Suspension Runners: Install suspension system runners so they are square and securely interlocked with one another. Install number and use on-center spacing per wood ceiling manufacturer's instructions, as indicated on approved Shop Drawings and in compliance with all local codes.

3.4 CLEANING

- A. General: Clean exposed wood surfaces of wood grille panels. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace wood ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**END OF SECTION**

**SECTION 09 61 16**  
**CONCRETE FLOOR SEALING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This Section includes:
  - 1. Sealing of concrete floor areas not otherwise scheduled to receive finish floor covering.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Include data to indicate chemical, solvent, and detergent resistance.
  - 2. Include information for primer, sealants, accessories and other required components.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fluid-applied floor sealer to include in maintenance manuals. Include the following:
  - 1. Manufacturer's instructions on maintenance renewal of applied treatments.
  - 2. Protocols and product specifications for joint filing, crack repair and/or surface repair.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 10 years documented experience.
- B. Installer Qualifications: An installer (applicator) who is approved, trained, or certified by fluid-applied floor sealer manufacturer.
- C. Source Limitations: Furnish products from one manufacturer for entire Project, unless otherwise acceptable to Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manner to prevent damage to containers and bags.
- B. Store materials in accordance with manufacturer's instructions in clean and dry location with temperature between 60 deg F and 90 deg F.
- C. Keep products away from fire or open flame.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.
  - 1. Do not apply flooring until spaces are enclosed and weatherproof; wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.
- B. Conditioning Period: Begins not less than 7 days before flooring application, is continuous through application, and continues not less than 3 days after application.
  - 1. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Ventilate area where flooring is being installed. Post and enforce no smoking and no open flame signs until flooring has cured.
- D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during floor sealer application.
- E. Close spaces to traffic during floor sealer application and for not less than 24 hours after application unless manufacturer recommends a longer period.



### 1.7 WARRANTY

- A. Provide written warranty signed by manufacturer warranting work to be free from defective materials and workmanship and agreeing to replace components which fail within 2 years from date of Substantial Completion.
  - 1. Failed materials and workmanship includes spalling, cracking, and delamination.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Dayton Superior Specialty Chemical Corp.
  - 2. L & M Construction Chemicals, Inc.
  - 3. Euclid Chemical.
  - 4. The Sherwin-Williams Company.

### 2.2 CONCRETE FLOOR SEALER

- A. Epoxy Floor Coating: Two component, water-based, high-performance, high-solids, epoxy floor coating system.
  - 1. Basis-of-Design Products:
    - a. The Sherwin-Williams Company; Armorseal 8100 Water Based Epoxy Floor Coating, clear.
    - b. Euclid; Euco 512 VOX Epoxy Sealer.
  - 2. Use sealers that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.3 ACCESSORIES

- A. Joint Sealant Materials: Manufacturer's recommended sealant compatible with flooring system for type of service and joint condition indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of flooring including substrate moisture content.
- B. Examine areas to receive flooring for:
  - 1. Defects in substrate that may affect proper execution of flooring work.
  - 2. Deviations beyond allowable tolerance for concrete slab work.
  - 3. Surface curing agents or sealers that would inhibit bond.
  - 4. Surface defects such as cracks that could transfer through to finished flooring surface if not corrected.
- C. Do not begin flooring work until concrete has cured a minimum of 28 days.
- D. Do not begin work until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare Substrate: Tests concrete substrate for pH, contaminants, and moisture content in accordance with manufacturer's recommendations. Ensure concrete is within manufacturers recommended limits prior to installation.
- B. Concrete Sub-floors: Verify that concrete slabs comply with ASTM D 4258 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
  - 2. Mechanically abrade or shot-blast concrete flooring to remove inappropriate curing agents and to open pores of concrete surfaces to allow penetration of bonding agent. Completely remove cleaning residue. Acid washing is not acceptable.
  - 3. Repair cracks, divots and surface imperfections according to manufacturer's instructions.
  - 4. Vacuum to remove dust and debris.
- C. Protect walls, floor openings, equipment, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.

3.3 APPLICATION

- A. General: Mix and apply flooring components according to manufacturer's written instructions.
- B. Apply a minimum of 2 coats in accordance with manufacturer's recommended coverage rates.

3.4 CURING

- A. Cure flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process.

3.5 CLEANING AND PROTECTION

- A. Clean as recommended by manufacturer. Do not use materials or methods which may damage surface or surrounding construction.
- B. Remove temporary covering and clean flooring prior to final inspection. Use cleaning materials and procedures recommended by flooring manufacturer.
- C. Do not permit traffic over finished flooring surfaces.
- D. Protect flooring materials from damage and wear during construction operation.

**END OF SECTION**

## SECTION 09 64 00

### WOOD FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Factory-finished wood flooring.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.
- C. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately 12 inches (300 mm) long and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

##### 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Wood Flooring: Equal to 1 percent of amount installed for each type, color, and finish of wood flooring indicated.

##### 1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wood flooring materials in unopened cartons or bundles.
- B. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet-work is complete and dry.
- C. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

##### 1.6 FIELD CONDITIONS

- A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.
  - 1. Environmental Conditioning: Maintain ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
  - 2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.
    - a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.
    - b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.
- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.
  - 1. Certification: Provide flooring that carries NWFA grade stamp on each bundle or piece.
- B. Maple Flooring: Comply with applicable MFMA grading rules for species, grade, and cut.
  - 1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- C. Softwood Flooring: Comply with WCLIB No. 17 grading rules for species, grade, and cut.

### **2.2 FACTORY-FINISHED WOOD FLOORING**

- A. Engineered-Wood Flooring: HPVA EF.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aged Woods, Inc.
    - b. Anderson Tultex
    - c. Bellawood.
    - d. Boen Hardwood Flooring Inc.
    - e. Bruce Hardwood.
    - f. Carlisle Wide Plank Floors.
    - g. EcoTimber.
    - h. Mannington Mills, Inc.
    - i. Nydree Flooring.
    - j. Woodwright.
  - 2. Basis-of-Design Product: As scheduled.
  - 3. Species and Grade: As scheduled.
  - 4. Thickness: As scheduled.
  - 5. Construction: Five ply.
  - 6. Face Width: Manufacturer's standard.
  - 7. Length: Manufacturer's standard.
  - 8. Edge Style: Square.
  - 9. Nosings: As scheduled.
  - 10. Finish: UV urethane.
    - a. Color: As scheduled.

### **2.3 ACCESSORY MATERIALS**

- A. Wood Subfloor: As specified in Section 06 16 36 "Wood Panel Product Sheathing."
- B. Wood Underlayment: As specified in Section 06 16 36 "Wood Panel Product Sheathing."
- C. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils (0.15 mm) thick.
- D. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.
- E. Fasteners: As recommended by manufacturer, but not less than that recommended in NWFA's "Installation Guidelines."
- F. Cork Expansion Strip: Composition cork strip.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

### 3.2 PREPARATION

- A. Concrete Slabs:
  - 1. Grind high spots and fill low spots to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10-foot (3-m) straight edge.
  - 2. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
  - 3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- B. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in NWFA's "Installation Guidelines."
- B. Wood Subfloor: Install according to requirements in Section 06 16 36 "Wood Panel Product Sheathing."
- C. Wood Underlayment: Install according to requirements in Section 06 16 36 "Wood Panel Product Sheathing."
- D. Provide expansion space at walls and other obstructions and terminations of flooring as indicated on Drawings.
- E. Vapor Retarder: Comply with the following for vapor retarder installation:
  - 1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
- F. Engineered-Wood Flooring: Nail or staple.

### 3.4 PROTECTION

- A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.
  - 1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

**END OF SECTION**

## SECTION 09 64 34

### HARDBOARD STAGE FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Provide anchored resilient wood flooring system with hardboard surface.

##### 1.2 SCOPE OF WORK

- A. Furnish all labor, materials, tools, equipment, transportation, services, and supervision necessary to complete installation of resilient stage floor system. The work is comprised of, but not limited to, the following principal items:
  - 1. Sheet moisture retarder on substrate surface.
  - 2. Plywood subflooring and cushion sleepers.
  - 3. Tempered-hardboard flooring, screwed.
  - 4. Surface finishing.

##### 1.3 JOB CONDITIONS

- A. Verify conditions applicable or pertaining to this work. Coordinate with scheduled work of other trades and notify Architect in writing of discrepancies, conflicts, or omissions prior to bid time or correct same at Contractor's expense.
- B. Do not deliver or install flooring until after spaces to receive flooring have been enclosed, are dry, and maintained at or above the same humidity conditions as will prevail during occupancy. Place materials in spaces to be floored 10 days prior to start of installation. Open packaging to permit natural adjustment of moisture content. Maintain ambient temperature range of 65 degrees F to 75 degrees F prior to, during and after installation.
- C. If existing conditions make installation of work as shown impossible, prepare drawings for Architect's review showing how work may be installed.
- D. Do not damage materials or equipment to be reused. Disconnect wiring only as required to install new materials or equipment. Existing construction to remain that is damaged by the Contractor shall be repaired or replaced at no cost to the Owner.
- E. Owner assumes no responsibility for actual condition of area affected by the work. Conditions existing at time of inspection will be maintained by Owner in so far as practicable.

##### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Flooring manufacturer shall be a firm established in the industry, been in business for minimum 10-years. Manufacturer shall submit a list of projects where the specified flooring has been installed. Square footage of these projects must total at least 150,000 square feet.
- B. Installer Qualifications: Installer shall have a minimum five continuous years' experience and be approved by manufacturer of flooring materials.
- C. Single Installer Responsibility: Entire resilient wood floor system shall be installed by a single firm, for undivided responsibility. Include anchorage system, sleepers, sub-flooring, adhesives or mastics, resilient mounts, flooring, insulation, trim, expansion provisions, and other accessory items as indicated, or as required.
- D. Performance Qualifications of Flooring System: Shock absorption shall average 53% min. (DIN 18032 Part II). "Uniformity" of shock absorption of plus or minus 5 percentage points shall be maintained throughout entire surface at each test point using DIN test 18032 Part II.
- E. Warranty: Warrant the product and installation for a period of 2-years from date of acceptance. An unsigned copy of the Warranty must accompany product samples before a contract for installation is issued.

#### 1.5 SUBMITTALS

- A. Shop Drawings:
  - 1. Indicate floor joint pattern, grain direction, and termination details.
  - 2. Indicate provisions for expansion and contraction.
- B. Product Data: Provide data for floor materials and floor finishing system.
- C. Samples: Submit one 12-inch by 12-inch sample illustrating floor finish, color and sheen.
- D. Submit certification that products meet or exceed specified requirements.
- E. Manufacturers Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Protect wood flooring from excessive moisture in shipment, storage and handling. Deliver in unopened bundles and store in a dry place, with adequate air circulation. Materials shall not be delivered to building until wet work such as concrete and plaster have been completed and cured to a condition of equilibrium.

### **PART 2 - PRODUCTS**

#### 2.1 GENERAL

- A. All materials shall be new and of first quality. All materials and equipment shall be manufactured and installed in accordance with applicable standards of the American National Standards Institute (ANSI), the American Hardboard Association (AHA), the American Lumber Standards Committee (ALSC), the American Plywood Association (APA), the Surface Burning Characteristics of Building Materials (ASTM E84), the American Wood Preservers Association (AWPA) - All Timber Products - Preservative Treatment by Pressure Process, the Southern Pine Inspection Bureau (SPIB), the West Coast Lumber Inspection Bureau (WCLIB), the Western Wood Products Association (WWPA), and DIN test 18032-Part II, Otto-Graf Institut, Stuttgart, plus any local applicable codes having jurisdiction.

#### 2.2 PRIMARY MATERIALS

- A. Tempered Hardboard: A product complying with American National Standard A135.4-1982, Class-1, tempered in 4 feet by 4 feet factory cut panels, surface S1S, nominal 1/4-inch thick. Actual panel dimensions shall be 47.999 inches to 48.001 inches, as delivered.
- B. Plywood Subflooring:
  - 1. Two layers of 3/4 inch thick by 4 feet by 8 feet CD-Exterior Grade, Fir or Southern Pine.
- C. Sleepers and Shims: Softwood lumber, pressure treated for moisture protection, 2 by 3 inch size.

#### 2.3 ACCESSORY MATERIALS

- A. Plywood Subflooring: One layer 3/4-inch and one layer 1/2-inch at Masonite floor.
- B. Fasteners:
  - 1. Flooring Nails: as recommended by flooring manufacturer.-
- C. Cork Expansion Strip: Composition cork expansion strip; FS HH-C 576, Type I-B, Class 2.

#### 2.4 FINISHES

- A. Paint:
  - 1. First Coat: Sherwin Williams Enamel Undercoater.
  - 2. Second and Third Coat: Sherwin Williams Pro-Mar 200 Latex Paint, flat black.
  - 3. Ensure surface is finished-sanded prior to paint application.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Verify that substrate surface is smooth and flat to plus or minus 1/8" over 10 feet.

#### 3.2 PREPARATION

- A. Broom clean substrate surfaces.

- B. Conditioning: Do not proceed with delivery and installation of flooring until after spaces to receive flooring have been enclosed and are dry and maintained at or above approximately the same humidity condition as planned for occupancy. Place flooring materials in spaces to be floored 10 days prior to start of installation. Open packages of flooring which are sealed (if any) to permit natural adjustment of moisture content.
- C. Tempered Hardboard Preparation: At least 10 days prior to installation of floor, Contractor shall prepare tempered hardboard for installation by assuring maximum moisture content, and maximum expanded size. Sprinkle the stacked hardboard with water until outer surfaces of the edge and top are wet. Cover entire stack with polyethylene sheet so that moisture can permeate the entire stack. Do not allow hardboard to freeze. After moisture content of tempered hardboard has been raised, install before hardboard dries out. During installation process, the remaining stack of hardboard shall be kept covered with polyethylene sheet at all times. Contractor shall check moisture content on a daily basis and add water as required to maintain desired conditions.

### 3.3 INSTALLATION

- A. Comply with flooring manufacturer's instructions and recommendations for applications indicated.
- B. Install first layer of plywood subfloor perpendicular to sleeper channels and fasten subfloor along sleepers as specified. Install second layer of plywood subfloor perpendicular to first layer and securely fasten both layers of subfloor every 6 inches along each sleeper.
- C. Install tempered hardboard flooring by screwing to subfloor, leaving 3/32-inch gaps between panels for expansion with end joints staggered. Hardboard shall be installed with tempered side up. Leave 1/8-inch joint for expansion at edge of floor. Pre-drill and counter-sink screws through hardboard panel face extending minimum of 1 inch into substrate. Locate screws at center of panels, at panel corners, and at 12 inches intervals around perimeter of each panel. Screws at edge should be 1/2-inch from edge.
- D. Level the installed flooring to +/- 1/8 inch over 10 feet.

### 3.4 FINISHING - HARDBOARD FLOORING

- A. Remove dust by vacuum or tack floor before first coat of finish.
- B. Protect adjacent surfaces.

### 3.5 PROTECTION

- A. Protect completed flooring during remainder of construction period with heavy Kraft paper or other suitable covering, so that flooring and finish will be without damage or deterioration at time of acceptance.

### 3.6 CLEANING

- A. Clean work areas of trash and debris.
- B. Clean floor surfaces in accordance with manufacturer's instructions.

**END OF SECTION**



## SECTION 09 65 13

### RESILIENT BASE AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Thermoset-rubber base.
  - 2. Rubber molding accessories.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

##### 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

##### 1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

##### 1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

## **PART 2 - PRODUCTS**

### **2.1 THERMOSET-RUBBER BASE**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  - 2. Flexco.
  - 3. Johnsonite; a Tarkett company.
  - 4. Roppe Corporation, USA.
- B. Basis-of-Design Product: As scheduled.
- C. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
  - 1. Style and Location: As scheduled
- D. Thickness: 0.125 inch (3.2 mm).
- E. Height: As indicated on Drawings.
- F. Lengths: Coils in manufacturer's standard length.
- G. Outside Corners: Job formed.
- H. Inside Corners: Job formed.
- I. Colors: As scheduled.

### **2.2 RUBBER MOLDING ACCESSORY**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Roppe Corporation, USA.
  - 2. VPI Corporation.
- B. Profile and Dimensions: As indicated.
- C. Locations: Provide rubber molding accessories in areas indicated.
- D. Colors and Patterns: As Scheduled.

### **2.3 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
    - a. Miter corners to minimize open joints.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

**END OF SECTION**

## SECTION 09 65 16

### RESILIENT SHEET FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl sheet flooring.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient sheet flooring.
  - 1. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples for Initial Selection: For each type of resilient sheet flooring indicated.
- D. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections of each color, texture, and pattern required.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.
- E. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.
- F. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Resilient Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations indicated.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive resilient sheet flooring during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during resilient sheet flooring installation.
- D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.
- E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL SHEET FLOORING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Altro Group.
  - 2. Armstrong World Industries, Inc.
  - 3. Forbo Industries, Inc.
  - 4. Gerflor.
  - 5. Interface.
  - 6. Mannington Mills, Inc.
  - 7. Patcraft; a division of Shaw Industries, Inc.
  - 8. Shaw Contract Group; a Berkshire Hathaway company.
  - 9. Tarkett.
- B. Basis-of-Design Product: As scheduled.
- C. Product Standard:
  - 1. Without Backing: ASTM F 1303.
  - 2. With Backing: ASTM F 1913.
  - 3. Overall Thickness: As standard with manufacturer.
- D. Wearing Surface: Manufacturer's standard.
- E. Sheet Width: As standard with manufacturer.
- F. Seamless-Installation Method: Heat welded.
- G. Colors and Patterns: As scheduled.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

- C. Seamless-Installation Accessories:
  - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
    - a. Colors: As selected by Architect from manufacturer's full range.
- D. Integral-Flash-Cove-Base Accessories:
  - 1. Cove Strip: 1-inch (25-mm) radius provided or approved by resilient sheet flooring manufacturer.
  - 2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.
  - 3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

#### **3.3 RESILIENT SHEET FLOORING INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
  - 1. Maintain uniformity of flooring direction.

2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
  3. Match edges of flooring for color shading at seams.
  4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
  - E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
  - F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
  - G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
  - H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
  - I. Seamless Installation:
    1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
  - J. Integral-Flash-Cove Base: Cove resilient sheet flooring to dimension indicated up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
    1. Install metal corners at inside and outside corners.
- 3.4 CLEANING AND PROTECTION
- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
  - B. Perform the following operations immediately after completing resilient sheet flooring installation:
    1. Remove adhesive and other blemishes from surfaces.
    2. Sweep and vacuum surfaces thoroughly.
    3. Damp-mop surfaces to remove marks and soil.
  - C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
  - D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.
    1. Apply three coat(s).
  - E. Cover resilient sheet flooring until Substantial Completion.

**END OF SECTION**

## SECTION 09 65 19

### RESILIENT TILE FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Solid vinyl floor tile.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

##### 1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.



- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

## **PART 2 - PRODUCTS**

### **2.1 SOLID VINYL FLOOR TILE**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Biltrite.
  - 2. Armstrong World Industries, Inc.
  - 3. Congoleum Corporation.
  - 4. Johnsonite; a Tarkett company.
  - 5. Mannington Mills, Inc.
  - 6. Patcraft; a division of Shaw Industries, Inc.
  - 7. Polyflor, Ltd.; distributed by Gerbert Limited.
  - 8. Shaw Contract Group; a Berkshire Hathaway company.
  - 9. VPI Corporation.
- B. Basis-of-Design Product: As scheduled.
- C. Tile Standard: ASTM F 1700.
  - 1. Class and Type: As scheduled.
- D. Thickness: As scheduled.
- E. Size: As scheduled.
- F. Colors and Patterns: As scheduled.

### **2.2 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75percent relative humidity level measurement.
  - C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
  - D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
    1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
  - E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.
- 3.3 FLOOR TILE INSTALLATION
- A. Comply with manufacturer's written instructions for installing floor tile.
  - B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
    1. Lay tiles in pattern indicated.
  - C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
    1. Lay tiles in pattern of colors and sizes indicated.
  - D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
  - E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
  - F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
  - G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- 3.4 CLEANING AND PROTECTION
- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
  - B. Perform the following operations immediately after completing floor tile installation:
    1. Remove adhesive and other blemishes from surfaces.
    2. Sweep and vacuum surfaces thoroughly.
    3. Damp-mop surfaces to remove marks and soil.
  - C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
  - D. Cover floor tile until Substantial Completion.

**END OF SECTION**

## SECTION 09 65 43

### LINOLEUM FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Linoleum floor tile.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of linoleum flooring.
  - 1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples for Initial Selection: For each type of linoleum flooring indicated.
- D. Samples for Verification: For each type of linoleum flooring, in manufacturer's standard size, but not less than 6-by-9-inch (152-by-230-mm) sections of each different color and pattern required.
- E. Product Schedule: For linoleum flooring. Use same designations indicated on Drawings.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of linoleum flooring to include in maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for flooring installation and seaming methods indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations indicated.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 90 deg F (32 deg C).
  - 1. Floor Tile: Store on flat surfaces.

## 1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring during the following periods:
  - 1. 72 hours before installation.
  - 2. During installation.
  - 3. 72 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during flooring installation.
- D. Close spaces to traffic for 72 hours after flooring installation.
- E. Install flooring after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 LINOLEUM FLOOR TILE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Forbo Industries, Inc.
- B. Basis-of-Design Product: As scheduled.
- C. Linoleum Floor Tile: ASTM F 2195.
  - 1. Nominal Floor Tile Size: As scheduled.
- D. Thickness: Manufacturer' standard.
- E. Colors and Patterns: As scheduled.

### 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by linoleum flooring manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.

- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install flooring until materials are the same temperature as space where they are to be installed.
  - 1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

### 3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing flooring.
- B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- E. Install flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 LINOLEUM FLOOR TILE INSTALLATION

- A. Lay out linoleum floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay floor tiles in pattern indicated.
- B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
  - 1. Lay floor tiles in pattern of colors and sizes indicated.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.
- B. Perform the following operations immediately after completing linoleum flooring installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect linoleum flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Floor Polish: Remove soil, adhesive, and blemishes from linoleum flooring surfaces before applying liquid floor polish.
  - 1. Apply two coat(s), minimum.
- E. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

**END OF SECTION**

## SECTION 09 66 23

### RESINOUS MATRIX TERRAZZO FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Thin-set, epoxy-resin terrazzo flooring.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
    - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - c. Review special terrazzo designs and patterns.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:
  - 1. Divider strips.
  - 2. Control-joint strips.
  - 3. Accessory strips.
  - 4. Abrasive strips.
  - 5. Stair treads, risers, and landings.
  - 6. Terrazzo patterns.
- C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- D. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:
  - 1. Terrazzo: 6-inch- (150-mm-) square Samples.
  - 2. Accessories: 6-inch- (150-mm-) long Samples of each exposed strip item required.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Engage an installer who is a contractor member of NTMA.
  - 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockups for terrazzo including accessories.
    - a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.
    - b. Include first three stair treads.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- C. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- D. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

#### 2.3 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Crossfield Products Corp.
    - b. Doyle Dickerson Terrazzo, Inc.
    - c. Hi-Tek Polymers, Inc.
    - d. Key Resin Company.
    - e. Master Terrazzo Technologies LLC.
    - f. Sherwin-Williams Company, General Polymers.
    - g. Terrazzo & Marble Supply Companies.
  - 2. Basis-of-Design Product: As scheduled.
- B. Mix Color and Pattern: As scheduled.



C. Materials:

1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
2. Substrate-Crack-Suppression Membrane: Product of terrazzo-resin manufacturer, having minimum 120 percent elongation potential according to ASTM D 412.
  - a. Reinforcement: Fiberglass scrim.
3. Primer: Manufacturer's product recommended for substrate and use indicated.
4. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
  - a. Physical Properties without Aggregates:
    - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
    - 2) Minimum Tensile Strength: 3000 psi (20.7 MPa) per ASTM D 638 for a 2-inch (51-mm) specimen made using a "C" die per ASTM D 412.
    - 3) Minimum Compressive Strength: 10,000 psi (6.9 MPa) per ASTM D 695, Specimen B cylinder.
    - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
      - a) Distilled water.
      - b) Mineral water.
      - c) Isopropanol.
      - d) Ethanol.
      - e) 0.025 percent detergent solution.
      - f) 1.0 percent soap solution.
      - g) 5 percent acetic acid.
      - h) 10 percent sodium hydroxide.
      - i) 10 percent hydrochloric acid.
      - j) 30 percent sulfuric acid.
  - b. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4-inch (6.35-mm) nominal thickness, and cured for 7 days at 75 deg F (24 deg C) plus or minus 2 deg F (1 deg C) and at 50 percent plus or minus 2 percent relative humidity.
    - 1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch (6.35 mm) according to ASTM D 635.
    - 2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C) according to ASTM C 531.
5. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
  - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131/C 131M.
  - b. 24-Hour Absorption Rate: Less than 0.75 percent.
  - c. Dust Content: Less than 1.0 percent by weight.
6. Finishing Grout: Resin based.

2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.
  1. Material: White-zinc alloy.
  2. Top Width: As indicated.
- B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
  1. Base-bead strips for exposed top edge of terrazzo base.
  2. Edge-bead strips for exposed edges of terrazzo.
- D. Abrasive Strips: Three-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
  1. Width: 1/2 inch (12.7 mm).

2. Depth: As required by terrazzo thickness.
3. Length: 4 inches (100 mm) less than stair width.
4. Color: As selected by Architect from full range of industry colors.

## 2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
- B. Anchoring Devices:
  1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.
  1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
  2. Acid-Base Properties: With pH factor between 7 and 10.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
  1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
    - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
- D. Preinstallation Moisture Testing:
  1. Testing Agency: Engage a qualified testing agency to perform tests.
  2. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours when tested according to ASTM F 1869 using anhydrous calcium chloride.
    - b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F 2170 using in-situ probes.
  3. Proceed with terrazzo installation only after concrete substrates pass moisture testing.

- E. Moisture-Vapor-Emission-Control Membrane: Install according to manufacturer's written instructions.
  - 1. Install on concrete substrates that incorporate lightweight aggregates.
  - 2. Install concrete substrates that fail preinstallation moisture testing.
- F. Substrate-Crack-Suppression Membrane: Install to isolate and suppress substrate cracks according to manufacturer's written instructions.
  - 1. Prepare and prefill substrate cracks with membrane material.
  - 2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
  - 3. Reinforce membrane with fiberglass scrim.
- G. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
  - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Strip Materials:
  - 1. Divider and Control-Joint Strips:
    - a. Install control-joint strips back to back and directly above concrete-slab control joints.
    - b. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
    - c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
  - 2. Accessory Strips: Install in locations indicated.
- C. Apply primer to terrazzo substrates according to manufacturer's written instructions.
- D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
  - 1. Installed Thickness: As indicated on Drawings nominal.
  - 2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
    - a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
    - b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
    - c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 80-grit stones or with comparable diamond abrasives until grout is removed from surface.
  - 3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.
- E. Install and finish poured-in-place terrazzo stairs at the same time the adjacent terrazzo flooring is installed.
- F. Install and finish poured-in-place terrazzo base at the same time the adjacent terrazzo flooring is installed.

### 3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

### 3.5 CLEANING AND PROTECTION

- A. Cleaning:
  - 1. Remove grinding dust from installation and adjacent areas.
  - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
  - 1. Seal surfaces according to NTMA's written recommendations.
  - 2. Apply sealer according to sealer manufacturer's written instructions.

- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

## SECTION 09 68 13

### TILE CARPETING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes modular carpet tile.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
  - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  - 2. Carpet tile type, color, and dye lot.
  - 3. Type of subfloor.
  - 4. Type of installation.
  - 5. Pattern of installation.
  - 6. Pattern type, location, and direction.
  - 7. Pile direction.
  - 8. Type, color, and location of edge, transition, and other accessory strips.
  - 9. Transition details to other flooring materials.
- C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet Tile: Full-size Sample.
  - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups at locations and in sizes shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.7 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, the following:
    - a. More than 10 percent edge raveling, snags, and runs.
    - b. Dimensional instability.
    - c. Excess static discharge.
    - d. Loss of tuft-bind strength.
    - e. Loss of face fiber.
    - f. Delamination.
  - 3. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 CARPET TILE, CPT-01

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Interface, LLC.
  - 2. J&J Invision; J&J Industries, Inc.
  - 3. Mannington Mills, Inc.
  - 4. Milliken & Company.
  - 5. Mohawk Group (The); Mohawk Carpet, LLC.
  - 6. Patcraft; a division of Shaw Industries, Inc.
  - 7. Philadelphia Commercial; a division of Shaw Industries, Inc.
  - 8. Shaw Contract Group; a Berkshire Hathaway company.
  - 9. Tandus; a Tarkett company.
- B. Basis-of-Design Product: As scheduled.
- C. Color: As scheduled .
- D. Construction: Engaged tufted pattern loop.
- E. Pile Density: 9,310 oz. per sq. yd.
- F. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- G. Size: As scheduled.

2.2 CARPET TILE, CPT-02

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Interface, LLC.
  - 2. J&J Invision; J&J Industries, Inc.
  - 3. Mannington Mills, Inc.
  - 4. Milliken & Company.
  - 5. Mohawk Group (The); Mohawk Carpet, LLC.
  - 6. Patcraft; a division of Shaw Industries, Inc.
  - 7. Philadelphia Commercial; a division of Shaw Industries, Inc.

- 8. Shaw Contract Group; a Berkshire Hathaway company.
- 9. Tandus; a Tarkett company.
- B. Basis-of-Design Product: As scheduled.
- C. Color: As scheduled.
- D. Construction: Tufted cut and loop.
- E. Pile Density: 727 oz. per sq. yd.
- F. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- G. Size: As scheduled.

### 2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
  - D. Maintain pile-direction patterns indicated on Drawings.
  - E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
  - F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
  - G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
  - H. Install pattern parallel to walls and borders.
- 3.4 CLEANING AND PROTECTION
- A. Perform the following operations immediately after installing carpet tile:
    - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
    - 2. Remove yarns that protrude from carpet tile surface.
    - 3. Vacuum carpet tile using commercial machine with face-beater element.
  - B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
  - C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

**END OF SECTION**



## SECTION 09 72 00

### WALL COVERINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl wall covering.
  - 2. Wood-veneer wall covering.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, veneer matching, seams and termination points.
- C. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- (914-mm-) long in size.
  - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied. Show complete pattern repeat.
  - 2. Wood-Veneer Wall-Covering Sample: From same flitch to be used for the Work, with specified finish applied.
- D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

##### 1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
  - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
  - 1. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 50 or less.
  - 2. Fire-Growth Contribution: No flashover and heat and smoke release according to NFPA 265.

### **2.2 VINYL WALL COVERING**

- A. As scheduled.

### **2.3 WOOD-VENEER WALL COVERING**

- A. As scheduled.

### **2.4 ACCESSORIES**

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 09 91 23 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
  - 2. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

### **3.3 WALL-COVERING INSTALLATION**

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
  - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip or as recommended by wall covering manufacturer.

- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern as recommended by wall covering manufacturer above the finish floor.
- F. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

**END OF SECTION**

## SECTION 09 81 16

### ACOUSTICAL BLANKET INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Concealed building insulation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E 84.
  - 2. Fire-Resistance Ratings: ASTM E 119.
  - 3. Combustion Characteristics: ASTM E 136.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Glass-Fiber Insulation:
    - a. CertainTeed Corporation.
    - b. Johns Manville Corporation.
    - c. Owens Corning.
  - 2. Slag-Wool-/Rock-Wool-Fiber Insulation:
    - a. Fibrex Insulations Inc.
    - b. Owens Corning.
    - c. Thermafiber.

##### 2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
  - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Unfaced Mineral-Fiber Blanket Insulation (in walls): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Unfaced, Flexible Glass-Fiber Blanket Insulation (above ceilings): ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
  - 1. Nominal density of 1.0 lb/cu. ft., thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F.
  - 2. Nominal density of not less than 1.5 lb/cu. ft. nor more than 1.7 lb/cu. ft., thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.
  - 3. Combustion Characteristics: Passes ASTM E 136.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

#### **3.3 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

#### **3.4 INSTALLATION OF GENERAL BUILDING INSULATION**

- A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
  - 1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
  - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

#### **3.5 PROTECTION**

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION**

## SECTION 09 84 15

### CEMENTITIOUS WOOD FIBER ACOUSTICAL PANELS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Cementitious wood fiber plank acoustical wall panels and installation accessories.

##### 1.2 DEFINITIONS

- A. NRC: Noise reduction coefficient.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panel edge, core material, and mounting indicated.
- B. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at panel head, base, joints, and corners; and details at wall, floor base, and wall intersections. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of acoustical wall panel.
- B. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.
- B. Source Limitations: Obtain cementitious wood fiber acoustical wall panels through one source from a single manufacturer.
- C. Regulatory Requirements and Approvals: Comply with requirements below.
  - 1. Southern Building Code Congress International (SBCCI):
    - a. SBCCI Report 9406A.
  - 2. International Conference of Building Officials (ICBO):
    - a. ICBO Research Report No. 1116.
  - 3. Building Officials and Code Administrators International, Inc. (BOCA):
    - a. BOCA Research Report No. 86-39.
- D. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

##### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cementitious wood-fiber units from moisture.
- B. Comply with acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

- C. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
  - 1. Store cartons open at each end to stabilize moisture content and temperature.
- D. Handle units to prevent chipping, breaking, cracking, staining, soiling, warping, or other physical damage. Discard damaged units at time of installation.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above walls is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
  - 1. Maintain the following conditions in areas where acoustical materials are to be installed 24 hours before, during and after installation:
    - a. Relative Humidity: 65 - 75%.
    - b. Uniform Temperature: 55 - 70 degrees F (13 - 21 degrees C).
- C. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Wall Panel Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than 5 attachment devices.
- B. Provide new unopened cartons of extra materials, packaged with protective covering for storage, identified with appropriate labels.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Armstrong World Industries, Inc.
- B. Basis-of-Design Product: As scheduled.
  - 1. Thickness: 2 inches.

#### 2.2 MATERIALS

- A. Cementitious Wood-Fiber Units, General: Manufacturer's standard factory-cast structural units complying with the following requirements:
  - 1. Composition: Chemically processed long wood fibers mixed with Portland cement, ASTM C 150, Type III, pressure bonded to produce units of thicknesses and sizes indicated:
  - 2. Properties: As follows, determined according to test method indicated:
    - a. Noise Reduction Coefficient: NRC of not more than 0.90 ; ASTM C 423.
    - b. Light Reflectance: 75 percent; ASTM E 1349.
  - 3. Finish: Manufacturer's standard prime-painted finish.
- B. Accessories: Provide accessories as follows:
  - 1. Tectum Painted Head Drywall Screws:
    - a. Material: Steel.
    - b. Length: Manufacturer's standard.
    - c. Color: White.
  - 2. Tectum Moulding:
    - a. Material: Plastic.
    - b. Designation: CHC.

3. Tectum Touch-Up Paint:
  - a. Color: White.

## 2.3 ACOUSTICAL WALL PANEL SYSTEMS

- A. Acoustical Wall Panel systems, including the following:
  1. Interior Wall Panels:
    - a. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
    - b. Thickness: 2 inches (51 mm).
    - c. Edge: Long edge beveled unless noted otherwise.
    - d. Width: As indicated.
    - e. Length: As indicated.
    - f. Color: As scheduled
    - g. Mounting Style: "D", unless otherwise indicated. Provide all fasteners, and unfaced fiberglass insulation for a complete single source installation.

## 2.4 FABRICATION

- A. Sound-Absorption Performance: Provide acoustical wall panels with minimum NRCs indicated, as determined by testing per ASTM C 423 for mounting type specified.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
  1. Thickness.
  2. Edge straightness.
  3. Overall length and width.
  4. Squareness from corner to corner.
  5. Chords, radii, and diameters.
- C. Back-Mounting Devices: Concealed on backside of panel, recommended to support weight of panel, with base-support bracket system where recommended by manufacturer for additional support of panels, and as follows:
  1. Metal "Z" Clips: Two-part panel clips, with one part of each clip mechanically attached to back of panel and the other part to wall substrate, designed to allow for panel removal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.
  1. Examine surfaces scheduled to receive suspended or directly attached acoustical units for unevenness, irregularities and dampness that would affect quality and execution of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with the instructions and recommendations of the acoustical wall panel system manufacturer.
- B. Install materials in accordance with governing regulations, fire resistance rating requirements and industry standards applicable to work.
  1. Comply with CISCA Code of Practices.
- C. Install acoustical wall panels in locations indicated with surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- D. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.
- E. Screw head to be flush with panel surface.
- F. Securely affix wall panels by means of splines attached vertically to smooth wall or furring strips. Engage vertical kerfs on the edges of the wall panels with splines. Apply adhesive or use hook and loop fastening where necessary.
- G. Cover field cut edges by means of trim or other moldings.



H. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch (1.6 mm).
2. Variation of Panel Joints from Hairline: Not more than 1/16 inch (1.6 mm) wide.

3.3 CLEANING

- A. Clean exposed surfaces of acoustical panel, trim, moldings and suspension members to comply with manufacturer's instructions for cleaning.
- B. Touch up any minor finish damage.
- C. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.4 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that cementitious wood-fiber panels are without damage or deterioration at time of Substantial Completion.

**END OF SECTION**

## SECTION 09 84 33

### SOUND-ABSORBING WALL UNITS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-absorbing wall panels.
  - 2. Sound-diffusing wall panels.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For unit assembly and installation.
  - 1. Include plans, elevations, sections, and mounting devices and details.
  - 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
  - 3. Include details at cutouts and penetrations for other work.
  - 4. Include direction of fabric weave and pattern matching.
- C. Samples for Verification: For the following products:
  - 1. Fabric: Full-width by approximately 36-inch- (900-mm-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch- (300-mm-) square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets, switches, and thermostats.
  - 2. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  - 3. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd. (9 sq. m), full width of bolt.
  - 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

#### 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
  - 1. Build mockup of typical wall area as directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a lighting level of not less than 50 fc (538 lx) is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to the following:
    - a. Acoustical performance.
    - b. Fabric sagging, distorting, or releasing from panel edge.
    - c. Warping of core.
  - 2. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

### 2.3 SOUND-ABSORBING WALL UNITS

- A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. G&S Acoustics.
- C. Basis-of-Design Products: As scheduled.
  1. Panel Shape: As indicated on Drawings.
  2. Mounting: Back mounted with manufacturer's standard mounting method, secured to substrate.
  3. Core: Manufacturer's standard.
    - a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board.
  4. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
  5. Edge Profile: Custom profile as indicated on Drawings.
  6. Corner Detail in Elevation: Custom as indicated on Drawings with continuous edge profile indicated.
  7. Facing Material: As indicated on Drawings.
  8. Acoustical Performance: Sound absorption NRC of not less than 0.75 according to ASTM C 423 for Type A mounting according to ASTM E 795.
  9. Nominal Overall Panel Thickness: As indicated on Drawings.
  10. Panel Width: As indicated on Drawings.
  11. Panel Height: As indicated on Drawings.

### 2.4 SOUND-DIFFUSING WALL UNITS

- A. Sound-Diffusing Wall Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. G&S Acoustics.
- C. Basis-of-Design Products: As scheduled.
  1. Panel Shape: Pyramidal.
  2. Mounting: Back mounted with manufacturer's standard two-part clip at top and hook and loop at bottom, secured to substrate.
  3. Core: Manufacturer's standard, prepared for required acoustical performance.
  4. Edge Construction: Manufacturer's standard.
  5. Facing Material: As indicated on Drawings.
  6. Acoustical Performance: Sound absorption NRC of 0.20 according to ASTM C 423 for Type A mounting according to ASTM E 795.
  7. Panel Width: As indicated on Drawings.
  8. Panel Height: As indicated on Drawings.

### 2.5 MATERIALS

- A. Core Materials: Manufacturer's standard.
- B. Facing Material: Fabric from same dye lot; color and pattern as scheduled.
  1. Applied Treatments: Stain resistance and flame retardant.
- C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
  1. Adhesive Tape Strips: Manufacturer's standard 1/16-inch- (1.6-mm-) thick, double-sided foam tape.
  2. Hook-and-Loop Strips: Manufacturer's standard.
  3. Impaling Clips: Manufacturer's standard.
  4. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

## 2.6 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Edge Hardening: For glass-fiber board and mineral-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.
- C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
  - 1. Square Corners: Tailor corners.
  - 2. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
  - 3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.
- E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
  - 1. Thickness.
  - 2. Edge straightness.
  - 3. Overall length and width.
  - 4. Squareness from corner to corner.
  - 5. Chords, radii, and diameters.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain as indicated on Drawings.

### 3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm) in 48 inches (1200 mm), noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch (1.6-mm) variation from hairline in 48 inches (1200 mm), noncumulative.

### 3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 09 91 13

### EXTERIOR PAINTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.

##### 1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

##### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As scheduled.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed to view:
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.



3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Ferrous Metal, Semigloss, Exterior Acrylic-Enamel Finish: Primer is not required on shop-primed items; touch up shop primer where provided.
  - 1. PPG:
    - a. First Coat: Primer 4020 Pitt-Tech Plus Int./Ext. Primer DTM, 2.5 mils DFT.
    - b. Finish Coat: 4216 Pitt-Tech Plus Int./Ext. Semi-Gloss DTM, 2.5 mils DFT.
  - 2. Sherwin-Williams:
    - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-1300 Series 2.0 - 4.0 mils DFT.
    - b. Second Coat: Pro Industrial Acrylic Semi-Gloss, B66-650 Series 2.5 mils DFT.
  - 3. Behr:
    - a. First Coat: Behr Premium Plus Multi-Surface Primer & Sealer 436, 1.7 mil DFT.
    - b. Second Coat: Behr Direct To Metal Semi-Gloss Enamel 3200, 1.45 mils DFT
- B. Zinc-Coated (Galvanized) Metal, Semigloss, Exterior Acrylic-Enamel Finish:
  - 1. PPG:
    - a. Primer: 4020 Pitt-Tech Int./Ext. Primer/Finish DTM, 2.5 mils DFT.
    - b. Second Coat: 4216 Pitt-Tech Plus Int./Ext. Semi-Gloss DTM, 2.5 mils DFT
    - c. Third Coat: Same as second coat.
  - 2. Sherwin-Williams:
    - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-1300 Series 2.0 - 4.0 mils DFT.
    - b. Second Coat: Pro Industrial Acrylic Semi-Gloss, B66-650 Series 2.5 mils DFT.
    - c. Third Coat: Same as second.
  - 3. Behr:
    - a. Primer: Behr Premium Plus Multi-Surface Primer & Sealer 436, 1.7 mil DFT.
    - b. Second Coat: Behr Direct To Metal Semi-Gloss Enamel 3200, 1.45 mils DFT
    - c. Third Coat: Same as second coat.

**END OF SECTION**

## SECTION 09 91 23

### INTERIOR PAINTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.

##### 1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

##### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As scheduled.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 SURFACE PREPARATION OF PREVIOUSLY COATED SURFACES

- A. General:
  - 1. Remove cracked and deteriorated sealants and caulking.
  - 2. Remove chalk deposits and loose, blistered, peeling, scaling, or crazed finish to bare base material or sound substrate by scraping and sanding.
  - 3. Wash surfaces with solution of TSP to remove wax, oil, grease, and other foreign material; rinse, and allow to dry. Exercise caution that TSP solution does not soften existing coating.
  - 4. Abrade glossy surfaces by sanding or wiping with liquid de-glosser.
  - 5. Remove mildew as specified above.
  - 6. Test compatibility of existing coatings by applying new coating to small, inconspicuous area. If new coatings lift or blister existing coatings, request recommendation from Architect.
  - 7. Apply specified primer to surfaces scheduled to receive coatings.
- B. Gypsum Wallboard:
  - 1. Fill cracks and voids with spackling compound.
  - 2. Apply primer over bare surfaces and newly applied texture coatings.
- C. Metal:
  - 1. Remove rust from surfaces to bare metal in accordance with SP3 "Power Tool Cleaning".
  - 2. Exercise care not to remove galvanizing.
  - 3. Complete preparation as specified for new work.
- D. Wood:
  - 1. Fill cracks, crevices and nail holes with putty or wood filler.
  - 2. Apply primer over bare surfaces and filler material.

### 3.4 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
  - B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
  - C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
  - D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
  - E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
    1. Paint the following work where exposed in equipment rooms:
      - a. Equipment, including panelboards and switch gear.
      - b. Uninsulated metal piping.
      - c. Uninsulated plastic piping.
      - d. Pipe hangers and supports.
      - e. Metal conduit.
      - f. Plastic conduit.
      - g. Tanks that do not have factory-applied final finishes.
      - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    2. Paint the following work where exposed in occupied spaces:
      - a. Equipment, including panelboards.
      - b. Uninsulated metal piping.
      - c. Uninsulated plastic piping.
      - d. Pipe hangers and supports.
      - e. Metal conduit.
      - f. Plastic conduit.
      - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      - h. Other items as directed by Architect.
    3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
  - F. Rated Wall Assemblies Identification:
    1. Identify fire-rated wall assemblies with stenciled lettering on wall surface above ceiling line.
    2. Provide stenciled block letters in red to identify each rated wall assembly.
    3. Refer to Section 09 29 00 "Gypsum Board" and Life Safety Legend on Code Compliance Plan.
- 3.5 FIELD QUALITY CONTROL
- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
    1. Contractor shall touch up and restore painted surfaces damaged by testing.
    2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
- 3.6 CLEANING AND PROTECTION
- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
  - B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
  - C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.7 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board, Flat Latex-Based Acrylic Finish: 2 finish coats over a primer.
1. Behr:
    - a. Primer: Behr Premium Plus Interior Drywall Primer & Sealer 73, .09 mils DFT
    - b. Second Coat: Behr Pro i300 Interior Flat 310, 1.65 mils DFT.
    - c. Third Coat: Same as second coat.
  2. PPG:
    - a. Primer: 6-2 Speedhide Interior Latex Sealer
    - b. Second Coat: Speedhide Zero Interior Latex Flat 6-4110XI, 1.4 mils DFT.
    - c. Third Coat: Same as second coat.
  3. Sherwin-Williams:
    - a. Primer: Roller applied latex texturing compound, ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
    - b. Second Coat: ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series 1.6 mils DFT.
    - c. Third Coat: Same as second coat.
- B. Gypsum Board, Semigloss, Latex-Based Acrylic-Enamel Finish: 2 finish coats over a primer.
1. Behr:
    - a. Primer: Behr Premium Plus Interior Drywall Primer & Sealer 73, .09 mils DFT
    - b. Second Coat: Behr Pro i300 Interior Semi-Gloss 370, 1.45 mils DFT.
    - c. Third Coat: Same as second coat.
  2. PPG:
    - a. Primer: 6-2 Speedhide Interior Latex Sealer
    - b. Second Coat: Speedhide Zero Interior Latex semi-Gloss 6-4510XI, 1.3 mils DFT.
    - c. Third Coat: Same as second coat.
  3. Sherwin-Williams:
    - a. Primer: Roller applied latex texturing compound, ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
    - b. Second Coat: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series 1.6 mils DFT.
    - c. Third Coat: Same as second coat.
- C. Gypsum Board, Eggshell, Low Odor: 2 finish coats over a primer.
1. Behr:
    - a. Primer: Behr Premium Plus Interior Drywall Primer & Sealer 73, .09 mils DFT
    - b. Second Coat: Behr Pro i300 Interior Eggshell 330, 1.45 mils DFT.
    - c. Third Coat: Same as second coat.
  2. PPG:
    - a. Primer: 6-2 Speedhide Interior Latex Sealer, 1.2 mils DFT.
    - b. Second Coat: Speedhide Zero Interior Latex Eggshell 6-4310XI, 1.5 mils DFT.
    - c. Third Coat: Same as second coat.
  3. Sherwin-Williams:
    - a. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
    - b. Second Coat: ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series 1.7 mils DFT.
    - c. Third Coat: Same as second coat.
- D. Ferrous Metal, Eggshell, Acrylic-Enamel Finish: Two finish coats over a primer.
1. Behr:
    - a. Primer: Behr Premium Plus Multi-Surface Primer & Sealer 436, 1.7 mils DFT
    - b. Second Coat: Behr Direct To Metal Semi-Gloss Enamel 3200, 1.75 mils DFT
    - c. Third Coat: Same as second coat.
  2. PPG:
    - a. Primer: 4020 Pitt Tech Plus Acrylic Primer/finish DTM, 3.0 mils DFT.
    - b. Second Coat: 90-1110 Pitt-Tech Plus Int./Ext. Satin DTM Industrial Enamel. 2.0 mils DTM.
    - c. Third Coat: Same as second coat.

3. Sherwin-Williams:
  - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series 2.0 - 4.0 mils DFT.
  - b. Second Coat: Pro Industrial Acrylic Eg-Shel, B66-660 Series 2.5 mils DFT.
  - c. Third Coat: Same as second coat.
- E. Ferrous Metal, Epoxy, Semi-Gloss, Low VOC: 2 finish coats over a primer. Wherever wall surfaces are scheduled to receive epoxy paint, paint doors and frames within the wall with epoxy.
  1. Behr:
    - a. Primer: Behr Premium Plus Multi-Surface Primer & Sealer 436, 1.7 mils DFT
    - b. Second Coat: Behr Pro Pre-Catalyzed Waterborne Epoxy Semi-Gloss HP150, 1.5 mils DFT
    - c. Third Coat: Same as second coat.
  2. PPG:
    - a. Primer: 4020 Pitt Tech Plus Acrylic Primer/finish DTM Industrial, 3.0 mils DFT.
    - b. Second Coat: Pitt-Glaze WB1 Pre-Catalyzed Acrylic Epoxy Semigloss, 16-510, 3.0 mils DFT.
    - c. Third coat: Same as second coat.
  3. Sherwin-Williams:
    - a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series 2.0 - 4.0 mils DFT.
    - b. Second Coat: Water Based Catalyzed Epoxy, B70-200 Series, 3.0 mils DFT.
    - c. Third Coat: Same as second coat.
- F. Decking (Preprimed/Prefinished), Bar Joists (Shop Primed):
  1. Water-Based Acrylic Dry Fall:
    - a. Sherwin-Williams:
      - 1) First Coat: Low VOC Waterborne Acrylic Dryfall Flat B42W81 over prepared substrate.
      - 2) Second Coat: Same as first coat.

**END OF SECTION**

## SECTION 09 96 00

### HIGH-PERFORMANCE COATINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems.

##### 1.2 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

##### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
    - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

##### 1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).



- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

### **2.2 HIGH-PERFORMANCE COATINGS, GENERAL**

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- B. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Colors: As scheduled.

### **2.3 SOURCE QUALITY CONTROL**

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for coating and substrate indicated.
  - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
  - 1. Epoxy System:
    - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    - b. Intermediate Coat: Epoxy, high build, low gloss.
    - c. Topcoat: Epoxy, gloss.
- B. Galvanized-Metal Substrates:
  - 1. Epoxy System:
    - a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
    - b. Intermediate Coat: Epoxy, matching topcoat.
    - c. Topcoat: Epoxy, gloss.

**END OF SECTION**

**SECTION 10 11 00**  
**VISUAL DISPLAY UNITS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Visual display board assemblies.
  - 2. Hanging display systems.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
  - 3. Include sections of typical trim members.
- C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
  - 1. Samples of facings for each visual display panel type, indicating color and texture.
  - 2. Actual factory-finish color samples, applied to aluminum substrate.
  - 3. Include accessory Samples to verify color selected.
- D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each visual display unit, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical visual display unit in one classroom as directed by Architect. Include accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
  - 2. Warranty Period: 50 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.

### 2.2 VISUAL DISPLAY BOARD ASSEMBLY

- A. Visual Display Board Assembly: Field or factory fabricated.
  - 1. Assembly: Markerboard.
  - 2. Corners: Square.
  - 3. Width: As indicated on Drawings.
  - 4. Height: As indicated on Drawings.
  - 5. Mounting Method: Direct to wall.
- B. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
  - 1. Color: White.
- C. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.
  - 1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
  - 2. Aluminum Finish: Clear anodic finish.
- D. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- E. Combination Assemblies: Provide manufacturer's standard exposed trim between abutting sections of visual display panels.
- F. Chalktray: Manufacturer's standard; continuous.
  - 1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
- G. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.
  - 1. Size: 1 inch (25 mm) high by full length of visual display unit.
  - 2. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 (1200) inches (mm) of display rail or fraction thereof.
  - 3. Flag Holder: One for each room.
  - 4. Tackboard Insert Color: As selected by Architect from full range of industry colors.
  - 5. Aluminum Color: Match finish of visual display assembly trim.

### 2.3 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with high-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
  - 1. Face Sheet Thickness: 0.021 inch (0.53 mm) uncoated base metal thickness.

2. MDF Core: 7/16 inch (11 mm) thick; with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

#### 2.4 HANGING DISPLAY SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. AS Hanging Display Systems.
- B. Basis-of-Design Products:
  1. Display Reveal: AS Hanging Display Systems; Display Reveal A1025.
    - a. Weight Capacity: 110 lbs.
    - b. Finish: Anodized, silver satin.
  2. Cable: AS Hanging Display Systems; P-End Cable, Stainless Steel, C2004.
    - a. Weight Capacity: 45 lbs.
    - b. Length: As selected by Architect.

#### 2.5 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. MDF: ANSI A208.2, Grade 130.
- C. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- D. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- E. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 09 91 23 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.

#### 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

### 3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
  - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
  - 2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- C. Factory-Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with egg-size adhesive gobs at 16 inches (400 mm) o.c., horizontally and vertically.
- D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings, or if not indicated, at heights indicated below.
  - 1. Mounting Height for Grades 7 and Higher: 36 (914) inches (mm) above finished floor to top of chalktray.
- E. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches (400 mm) o.c.
  - 1. Mounting Height: 48 (1219) inches (mm) above finished floor to top of rail.
- F. Hanging Display Systems: Install in accordance with manufacturer's instructions and recommendations.

### 3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

**END OF SECTION**

## SECTION 10 12 00

### DISPLAY CASES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Display cases.

##### 1.2 DEFINITIONS

- A. Display Case: Glazed cabinet with back panel surface and adjustable shelves.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases. Include furnished specialties and accessories.
  - 2. Include electrical characteristics for illuminated display cases.
- B. Shop Drawings: For display cases.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show location of seams and joints in back panels.
  - 3. Include sections of typical trim members.
  - 4. Include diagrams for wiring of illuminated display cases.
- C. Samples for Initial Selection: For each type of exposed finish.
  - 1. Include Samples of back panels and factory-finished trim involving color finish selection.
- D. Samples for Verification: For each type of exposed finish for the following.
  - 1. Back Panel: Not less than 8-1/2 by 11 inches (215 by 280 mm), with facing and substrate indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6-inch- (150-mm-) long sections of each trim profile including corner section.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For fabrics, for tests performed by a qualified testing agency.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For display cases to include in maintenance manuals.

##### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install display cases for indoor installations until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain display cases from single source from single manufacturer.

##### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.



- B. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 DISPLAY CASES

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
  - 1. AJW Architectural Products; Display Cases.
- B. Recessed Display Case: Factory-fabricated display case; with finished interior, operable glazed doors at front, and trim on face to cover edge of recessed opening.
  - 1. Display Case Cabinet: Extruded aluminum.
  - 2. Face Frame: Aluminum.
  - 3. Aluminum Finish: Color anodic.
    - a. Color: Black.
- C. Glazed Hinged Doors: Tempered glass; set in frame matching cabinet material and finish. Equip each door with full-height continuous hinge and cylinder lock with two keys.
  - 1. Thickness: Not less than 6 mm thick.
  - 2. Number of Doors: As indicated on Drawings.
- D. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
  - 1. Shelf Depth: As indicated on Drawings.
  - 2. Number of Shelves: As indicated on Drawings.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface. Provide standards extending full height of display case.
  - 1. Basis-of-Design Product: Knappe & Vogt; 82-inch Series Standard and 182-inch Series Bracket System.
  - 2. Material: Steel.
  - 3. Finish: As selected by Architect from manufacturer's full range.
- F. Gypsum Board Back Panel: Gypsum board back panel, as specified in Section 09 29 00 "Gypsum Board."
- G. Illumination System: Concealed top-lighting system consisting of fluorescent-strip fixtures. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.
  - 1. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.
    - a. Electrical Characteristics: Refer to Electrical Engineer's documents.
- H. Size: As indicated on Drawings wide.

### 2.4 BACK PANELS

- A. Gypsum Board: As specified in Section 09 29 00 "Gypsum Board."

### 2.5 MATERIALS

- A. Extruded-Aluminum Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063.
- B. Aluminum Tubing: ASTM B 429/B 429M, Alloy 6063.
- C. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- D. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

### 2.6 FABRICATION

- A. Fabricate display cases to requirements indicated for dimensions, design, and thickness and finish of materials.
- B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.

- C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

#### 2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### 2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of illuminated units.
- C. Examine walls and partitions for proper backing for display cases.
- D. Examine walls and partitions for suitable framing depth if recessed units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare recesses for display cases as required by type and size of unit.

#### 3.3 INSTALLATION

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
  - 1. Mounting Height: 72 (1830) inches (mm) above finished floor to top of cabinet.
- B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches (400 mm) o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches (600 mm) o.c.
- C. Comply with requirements specified elsewhere for connecting illuminated display cases.
- D. Install display case shelving level and straight.

#### 3.4 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended in writing by manufacturer.
- B. Touch up factory-applied finishes to restore damaged areas.

**END OF SECTION**

## SECTION 10 14 00

### SIGNAGE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Identifying devices where shown on the Drawings complete and as specified including the following:
    - a. Parking signs indicating accessible spaces.
    - b. Interior code required signs.

##### 1.2 SUBMITTALS

- A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, accessories, layout, and installation details.

##### 1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
- B. Manufacturer shall have a minimum of five years experience in the manufacturing of signs specified.
- C. Codes and Standards:
  - 1. Panel signs shall have 1/32-inch raised copy and grade 2 Braille, and shall comply with all existing federal, state, and local accessibility standards.
  - 2. Code and Standards: Comply with American with Disabilities Act of 1990, Title 3 Provisions, Public Accommodations and Commercial Facilities. Updated March 15, 2012.
  - 3. Comply with the State of Texas Accessibility Standards, 2012 edition, as administered by the Texas Department of Licensing and Regulation.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Best Sign Systems, Montrose, Colorado.
  - 2. Mohawk Sign Systems, Schenectady, New York.
  - 3. Nelson-Harkins, Chicago, Illinois.
  - 4. ASI Signs, Dallas, Texas.

##### 2.2 HANDICAPPED PARKING

- A. Screen Printed Signs:
  - 1. 18 gage bonderized steel with blue baked enamel finish and white screen printed copy.
  - 2. Copy and Size:
    - a. "Handicapped Parking Only" – 12 inches by 18 inches.
    - b. "Van Accessible" – 12 inches by 6 inches.
  - 3. Acceptable Product: Best Traffic Signs No. SS04 with SS52 as required.
- B. Post: Galvanized pipe column minimum 9 feet long.

##### 2.3 ROOM SIGNAGE SYSTEMS

- A. Basis-of-Design Product: ASI Unframed SP Series Signs with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes and details.
- B. Sign Face: Clear acrylic, 0.080-inch thick, matte first surface.
  - 1. Adhesive: Pressure sensitive adhesive film, second surface.

- C. Tactile Graphics and Text:
  - 1. Fabrication: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's stratification process as follows:
    - a. Basis-of-Design Product: ASI Intouch, photo-mechanical method.
  - 2. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.
- D. Non-Tactile Graphics and Text:
  - 1. Fabrication options:
    - a. Basis-of-Design Product: ASI; Series SPE/SPJ: Non-tactile graphic plaque, no back plate.
  - 2. Text or graphic technique:
    - a. Screen process using subsurface method.
  - 3. Provide lettering and graphics precisely formed, uniformly opaque, and consistent in size, style, spacing, content, position, and colors.
- E. Overall Panel Size: Refer to Drawings.
- F. Panel Colors: As selected by Architect.
- G. Text or Graphic Colors: As selected by Architect.
- H. Letter styles, colors, letter sizes and layout position: As selected by Architect.
- I. Installation Method: System SA, silicone adhesive.

### **PART 3 - EXECUTION**

#### **3.1 DELIVERY AND STORAGE**

- A. Deliver and store identifying devices in protective wrappings until ready for installation. Install letters in protective wrappings and remove wrappings just prior to substantial completion.

#### **3.2 INSTALLATION**

- A. Install signs plumb, level and square and in proper planes with other work, at heights required by accessibility codes and standards.
- B. Anchor each plastic laminate sign with adhesive.
- C. Install signs with sufficient amount of foam tape for proper installation.
- D. Attach as recommended by sign manufacturer.
- E. Anchor each sign with adhesive.
- F. Coordinate arrival and installation of graphic signs with hardware installation. Graphic signs function as and are coordinated with the hardware as shown on the Drawings.
- G. Room name signs shall be placed on the public side of the door except where noted otherwise.
- H. Single Door Sign: Provide one sign as specified above, mounted to wall adjacent to door on knob side.
- I. Pair of Doors: Provide one sign as specified above, mounted to adjacent wall closest to active leaf of door. Do not install sign where it will be obstructed by door when door is in the 'open' position.
- J. Attachment: Mounting to surfaces shall be done by pressure sensitive frame double-faced tape. Signs shall be delivered to the project site with the tape in place and trimmed on each sign, but with the protective paper layer not removed. Paper layer shall be removed just prior to installation of signs.

#### **3.3 EXTERIOR INSTALLATION - PARKING SIGNS**

- A. Mount posts in 12-inch round by 2'-6" deep concrete footing.
- B. Handicapped Signs: Mount signs at height to comply with accessibility codes.

#### **3.4 COORDINATION**

- A. Coordinate the installation of the identifying devices with the hardware manufacturer for lockset and knob leave outs as detailed and scheduled.

#### **3.5 DAMAGE**

- A. Any identifying device which is scratched or defaced will be rejected.

3.6 CLEANING

- A. Remove protective materials and clean all signs. Clean surfaces with plain water or water with soap or household detergent.

**END OF SECTION**

## SECTION 10 14 16

### PLAQUES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes metal plaques.

##### 1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plaques.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each plaque at least half size.
- C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.
  - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Plaques: Full-size Sample.
  - 2. Exposed Accessories: Full-size Sample of each accessory type.
  - 3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
- E. Product Schedule: For plaques. Use same designations indicated on Drawings or specified.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For plaques to include in maintenance manuals.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

##### 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
  - 2. Warranty Period: Five years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design," the ABA standards of the Federal agency having jurisdiction, and Texas Accessibility Standards (TAS).

## 2.2 PLAQUES

- A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. A.R.K. Ramos.
    - b. ACE Sign Systems, Inc.
    - c. Erie Landmark Company; a division of Paul W. Zimmerman Foundries.
    - d. Gemini Incorporated.
    - e. Matthews International Corporation; Bronze Division.
    - f. Metal Arts.
    - g. Metallic Arts.
    - h. Signs & Decal Corp.
    - i. Southwell Company (The).
  - 2. Plaque Material: Cast aluminum.
  - 3. Plaque Thickness: 0.153 inch (3.89 mm).
  - 4. Finishes:
    - a. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
    - b. Overcoat: Manufacturer's standard baked-on clear coating.
  - 5. Background Texture: As selected by Architect from manufacturer's full range.
  - 6. Integrally Cast Border Style: As indicated on Drawings.
  - 7. Applied Frame Material, Style, and Finish: As indicated on Drawings.
  - 8. Mounting: As indicated on Drawings.
  - 9. Text and Typeface: Typeface as selected by Architect from manufacturer's full range.

## 2.3 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
  - 3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    - b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
  - 4. Plaque Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
    - b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard plaques according to requirements indicated.
  - 1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
  6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
- C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match plaque-background color unless otherwise indicated.
- 2.6 GENERAL FINISH REQUIREMENTS
- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.
- 2.7 ALUMINUM FINISHES
- A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
  2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
  4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Plaques Used for Room Identification and Other Accessible Plaques: Install in locations on walls as indicated on Drawings and according to accessibility standard.



C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
  - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
  - b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket supports in position, so that plaque is correctly located and aligned.
4. Shim-Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach plaques to plate using method specified above.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as plaques are installed.
- C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION**

## SECTION 10 14 19

### DIMENSIONAL LETTER SIGNAGE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Illuminated, fabricated channel dimensional characters.

##### 1.2 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

##### 1.3 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show locations of electrical service connections.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Dimensional Characters: Full-size Sample of each type of dimensional character.
  - 2. Exposed Accessories: Full-size Sample of each accessory type.
  - 3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
- D. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.
- E. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
  - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

##### 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

##### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
  - 1. Uniform Wind Load: As indicated on Drawings.
  - 2. Concentrated Horizontal Load: As indicated on Drawings.
  - 3. Other Design Load: As indicated on Drawings
  - 4. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 DIMENSIONAL CHARACTERS

- A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. A.R.K. Ramos.
    - b. APCO Graphics, Inc.
    - c. ASI Sign Systems, Inc.
    - d. Diskey Architectural Signage Inc.
    - e. Gemini Incorporated.
    - f. Southwell Company (The).
  - 2. Illuminated Characters: Backlighting character construction with LED lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
    - a. Power: As indicated on electrical Drawings.
    - b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
  - 3. Character Material: Sheet or plate aluminum.
  - 4. Material Thickness: As indicated on Drawings.
  - 5. Character Height: As indicated on Drawings.
  - 6. Character Depth: As indicated on Drawings.
  - 7. Finishes:
    - a. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
    - b. Overcoat: Manufacturer's standard baked-on clear coating.
  - 8. Mounting: As indicated on Drawings.
    - a. Hold characters at manufacturer's recommended distance from wall surface.
  - 9. Typeface: As selected by Architect from manufacturer's full range.

### 2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
  - 3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    - b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
  - 4. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
    - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
  - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
  - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
  - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
  2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
  3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
  4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

**END OF SECTION**

**SECTION 10 18 51**  
**SHOWER PANS**

**PART 1 - GENERAL**

- 1.1 SECTION INCLUDES
  - A. Shower pans.
- 1.2 SUBMITTALS
  - A. Product Data: Manufacturer's data sheets on each product to be used, including:
    - 1. Preparation instructions and recommendations.
    - 2. Storage and handling requirements and recommendations.
    - 3. Installation methods.
  - B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
  - C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.
  - D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- 1.3 QUALITY ASSURANCE
  - A. Manufacturer Qualifications: A manufacturer with a minimum of ten years' experience manufacturing bath and shower components.
  - B. Installer Qualifications: An installer who has demonstrated experience installing bath and shower components and as recommended by the manufacturer.
- 1.4 DELIVERY, STORAGE, AND HANDLING
  - A. Store products in manufacturer's unopened packaging until ready for installation.
- 1.5 PROJECT CONDITIONS
  - A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.6 WARRANTY
  - A. Provide manufacturer's standard 5-year limited warranty.

**PART 2 - PRODUCTS**

- 2.1 MANUFACTURERS
  - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1. American Bath Enterprises, Inc.
    - 2. Clarion Bathware.
    - 3. Signature Hardware.
    - 4. Sterling Division of Kohler.
- 2.2 PRODUCTS
  - A. Shower Receptor:
    - 1. Basis-of-Design Product: Signature Hardware; 64-inch Acrylic ADA Compliance Shower Tray – Center Drain.
      - a. Height: 3 inches.
      - b. Width: 35-1/2 inches.

**PART 3 - EXECUTION**

- 3.1 EXAMINATION
  - A. Do not begin installation until substrates have been properly prepared.

- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

## SECTION 10 21 13.17

### PHENOLIC-CORE TOILET COMPARTMENTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For toilet compartments.
  - 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show locations of centerlines of toilet fixtures.
  - 4. Show locations of floor drains.
- C. Samples for Initial Selection: For each type of toilet compartment material indicated.
  - 1. Include Samples of hardware and accessories involving material and color selection.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Door Hinges: One hinge(s) with associated fasteners.
  - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
  - 3. Door Bumper: One door bumper(s) with associated fasteners.
  - 4. Door Pull: One door pull(s) with associated fasteners.
  - 5. Fasteners: Ten fasteners of each size and type.

##### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and Texas Accessibility Standards (TAS) for toilet compartments designated as accessible.

##### 2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ampco Products, LLC.



2. Bobrick Washroom Equipment, Inc.
  3. Bradley Corporation.
  4. Hadrian Inc.
  5. Metpar Corp.
  6. Sanymetal, a Crane Plumbing company.
- B. Basis-of-Design Manufacturer: Hadrian Inc.
- C. Toilet-Enclosure Style: Floor anchored.
- D. Urinal-Screen Style: Wall hung.
- E. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
- F. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- G. Brackets (Fittings):
1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- H. Phenolic-Panel Finish:
1. Color and Pattern: As scheduled.
  2. Edge Color: Manufacturer's standard.
- 2.3 HARDWARE AND ACCESSORIES
- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless-steel continuous, cam type that swings to a closed or partially open position-, allowing emergency access by lifting door. Mount with through-bolts.
  2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
  3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
  4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
  5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
  6. Finish and Color: As selected by Architect from manufacturer's full range.
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.
- 2.4 MATERIALS
- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.
- 2.5 FABRICATION
- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch (13 mm).
    - b. Panels and Walls: 1 inch (25 mm).
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

#### **3.3 ADJUSTING**

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

**END OF SECTION**

## SECTION 10 26 00

### WALL AND DOOR PROTECTION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Wall guards.
  - 2. Corner guards.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.
- D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
  - 1. Wall Guards: 12 inches (300 mm) long. Include examples of joinery, corners, end caps, top caps, and field splices.
  - 2. Corner Guards: 12 inches (300 mm) long. Include example top caps.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 96-inch- (2400-mm-) long units.
  - 2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- (1200-mm-) long units.
  - 3. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

##### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
  - 2. Keep plastic materials out of direct sunlight.
  - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
    - a. Store corner-guard covers in a vertical position.
    - b. Store wall-guard- covers in a horizontal position.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and Texas Accessibility Standards (TAS).

### 2.3 WALL GUARDS

- A. Bumper Rail: Standard-duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Balco, Inc.
    - b. Construction Specialties, Inc.
    - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
    - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - e. Pawling Corporation.
  - 2. Bumper: Continuous, resilient bumper cushion(s).
  - 3. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
  - 4. Accessories: Concealed splices and mounting hardware.
  - 5. Mounting: Extended mounting on injection-molded plastic mounting brackets.

### 2.4 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arden Architectural Specialties, Inc.
    - b. Balco, Inc.
    - c. Construction Specialties, Inc.
    - d. IPC Door and Wall Protection Systems; Division of InPro Corporation.
    - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - f. Pawling Corporation.
  - 2. Basis-of-Design Products: As scheduled.
  - 3. Material: Stainless-steel sheet, Type 304.
    - a. Thickness: Minimum 0.0500 inch (1.3 mm).
    - b. Finish: As scheduled.
  - 4. Wing Size: Nominal 2-1/2 by 2-1/2 inches (65 by 65 mm), unless otherwise indicated.
  - 5. Corner Radius: 1/8 inch (3 mm).
  - 6. Mounting: Adhesive.

## 2.5 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.
- C. Adhesive: As recommended by protection product manufacturer.

## 2.6 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.7 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

### 3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
  - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
  - 2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
  - 3. Adjust end and top caps as required to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

**END OF SECTION**

## SECTION 10 28 00

### TOILET, BATH, AND LAUNDRY ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Public-use washroom accessories.
  - 2. Warm-air dryers.
  - 3. Childcare accessories.
  - 4. Underlavatory guards.
  - 5. Custodial accessories.

##### 1.2 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify accessories using designations indicated.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

##### 1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 15 years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue (Roll) Dispenser, TTD-1:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.

- e. Brey-Krause Manufacturing Co.
    - f. GAMCO Specialty Accessories; a division of Bobrick.
    - g. Tubular Specialties Manufacturing, Inc.
  2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-3588.
  3. Description: Double-roll dispenser.
  4. Mounting: Surface mounted.
  5. Operation: Noncontrol delivery with theft-resistant spindle.
  6. Capacity: Designed for 5-1/8 inch diameter tissue rolls.
  7. Material and Finish: Stainless steel, No. 4 finish (satin).
- B. Combination Toilet Tissue Dispenser, TTD-1 and TTD-2:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. Brey-Krause Manufacturing Co.
    - f. GAMCO Specialty Accessories; a division of Bobrick.
    - g. Seachrome Corporation.
    - h. Tubular Specialties Manufacturing, Inc.
  2. Basis-of-Design Products:
    - a. Bobrick Washroom Equipment, Inc.; Model B-3092.
    - b. Bobrick Washroom Equipment, Inc.; Model B-3579.
  3. Description: Combination unit with double-roll toilet tissue dispenser and the following:
    - a. Removable sanitary-napkin waste receptacle with self-closing, disposal-opening cover.
    - b. Seat-cover dispenser with minimum capacity of 500 single or half-fold seat covers.
  4. Mounting: Recessed and surface mounted, where indicated.
  5. Toilet Tissue Dispenser Capacity: 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
  6. Toilet Tissue Dispenser Operation: Noncontrol delivery with theft-resistant spindles.
  7. Material and Finish: Stainless steel, No. 4 finish (satin).
  8. Lockset: Tumbler type.
- C. Waste Receptacle, WR-1:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. Brey-Krause Manufacturing Co.
    - f. GAMCO Specialty Accessories; a division of Bobrick.
    - g. Tubular Specialties Manufacturing, Inc.
  2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-35633.
  3. Mounting: Self-closing disposal-opening cover, recessed.
  4. Minimum Capacity: 3 gal.
  5. Material and Finish: Stainless steel, No. 4 finish (satin).
  6. Liner: Reusable vinyl liner.
  7. Lockset: Tumbler type for waste receptacle.
- D. Combination Towel (Folded) Dispenser/Waste Receptacle, PTDWR-1:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. Brey-Krause Manufacturing Co.
    - f. GAMCO Specialty Accessories; a division of Bobrick.
    - g. Seachrome Corporation.
    - h. Tubular Specialties Manufacturing, Inc.
  2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-38034.



3. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
  4. Mounting: Recessed.
    - a. Designed for nominal 4-inch (100-mm) wall depth.
  5. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
  6. Minimum Waste-Receptacle Capacity: 3.8 gal.
  7. Material and Finish: Stainless steel, No. 4 finish (satin).
  8. Liner: Reusable, vinyl waste-receptacle liner.
  9. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- E. Automatic Liquid-Soap Dispenser, SD-1:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. GAMCO Specialty Accessories; a division of Bobrick.
    - f. Sloan Valve Company.
    - g. Stern Engineering Ltd.
  2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-2012.
  3. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing antibacterial soap in liquid or lotion form.
  4. Mounting: Wall mounted.
  5. Capacity: 850 mL.
  6. Materials: Stainless steel, Type 304.
- F. Grab Bar, GB-1, GB-2, and GB-3:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. Brey-Krause Manufacturing Co.
    - f. GAMCO Specialty Accessories; a division of Bobrick.
    - g. Tubular Specialties Manufacturing, Inc.
  2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model 150C.MBLK.
  3. Mounting: Flanges with concealed fasteners.
  4. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
    - a. Finish: Matte black.
  5. Outside Diameter: 1-1/2 inches (38 mm).
  6. Configuration and Length: As indicated on Drawings.
- G. Sanitary-Napkin Disposal Unit, SND-1:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
    - c. Bobrick Washroom Equipment, Inc.
    - d. Bradley Corporation.
    - e. Brey-Krause Manufacturing Co.
    - f. GAMCO Specialty Accessories; a division of Bobrick.
    - g. Seachrome Corporation.
    - h. Tubular Specialties Manufacturing, Inc.
  2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-35139.
  3. Mounting: Surface mounted.
  4. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
  5. Receptacle: Removable.
  6. Material and Finish: Stainless steel, No. 4 finish (satin).

H. Seat-Cover Dispenser, TSD-1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Brey-Krause Manufacturing Co.
  - f. GAMCO Specialty Accessories; a division of Bobrick.
  - g. Seachrome Corporation.
  - h. Tubular Specialties Manufacturing, Inc.
2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-221.
3. Mounting: Surface mounted.
4. Minimum Capacity: 250 seat covers.
5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type.

I. Mirror Unit, MRR-1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Brey-Krause Manufacturing Co.
  - f. GAMCO Specialty Accessories; a division of Bobrick.
  - g. Tubular Specialties Manufacturing, Inc.
2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; Model B-290.
3. Frame: Stainless-steel channel.
  - a. Corners: Manufacturer's standard.
4. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
  - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
5. Size: As indicated on Drawings.

J. Coat Hook, CH-1 AND CH-2:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Brey-Krause Manufacturing Co.
  - f. GAMCO Specialty Accessories; a division of Bobrick.
  - g. Tubular Specialties Manufacturing, Inc.
2. Basis-of-Design Product:
  - a. Bobrick Washroom Equipment, Inc.; Model B-9541.
  - b. Bobrick Washroom Equipment, Inc.; Model B-9542.
3. Description: Single-prong unit.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

2.2 WARM-AIR DRYERS

A. High-Speed Warm-Air Dryer:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AJW Architectural Products.
  - b. American Dryer, Inc.
  - c. American Specialties, Inc.
  - d. Bradley Corporation.

- e. Dyson.
- f. Excel Dryer Inc.
- g. GAMCO Specialty Accessories; a division of Bobrick.
- h. Saniflow Hand Dryer Corporation.
- i. Sloan Valve Company.
- j. World Dryer Corporation.
2. Basis-of-Design Product: Dyson; Airblade V.
3. Description: High-speed, warm-air hand dryer for rapid hand drying.
4. Mounting: As indicated.
5. Operation: Electronic-sensor activated with operation time of 10 to 20 seconds.
6. Cover Material and Finish: As selected by Architect from manufacturer's full range.
7. Electrical Requirements: As indicated in Electrical Engineer's documents.

### 2.3 CHILDCARE ACCESSORIES

#### A. Diaper-Changing Station, DCS-1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. American Specialties, Inc.
  - b. Diaper Deck & Company, Inc.
  - c. Foundations Children's Products.
  - d. GAMCO Specialty Accessories; a division of Bobrick.
  - e. Koala Kare Products.
  - f. SafeStrap Company, Inc. (SSC, Inc.).
  - g. Tubular Specialties Manufacturing, Inc.
2. Basis-of-Design Product: Koala Kare Products; KB310-SSRE Horizontal Stainless Steel Recessed-Mounted Baby Changing Station.
3. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
  - a. Engineered to support minimum of 250-lb (113-kg) static load when opened.
4. Mounting: Recessed.
5. Operation: By pneumatic shock-absorbing mechanism.
6. Material and Finish: Stainless steel, No. 4 finish (satin), with injection-molded polypropylene interior.
7. Liner Dispenser: Built in.

### 2.4 UNDERLAVATORY GUARDS

#### A. Underlavatory Guard:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Plumberex Specialty Products, Inc.
  - b. Truebro by IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

### 2.5 CUSTODIAL ACCESSORIES

#### A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

#### B. Mop and Broom Holder:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AJW Architectural Products.
  - b. American Specialties, Inc.
  - c. Bobrick Washroom Equipment, Inc.
  - d. Bradley Corporation.
  - e. Brey-Krause Manufacturing Co.
  - f. GAMCO Specialty Accessories; a division of Bobrick.
  - g. Tubular Specialties Manufacturing, Inc.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.

3. Length: 36 inches (914 mm).
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
  - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

## 2.6 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

**END OF SECTION**

## **SECTION 10 41 00**

### **FIRE DEPARTMENT ACCESS LOCK AND VAULT**

#### **PART 1 - GENERAL**

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Miscellaneous specialty items as listed herein.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Including all pertinent performance characteristics and criteria.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Instructions: For installation, maintenance, and repair.

#### **PART 2 - PRODUCTS**

##### 2.1 PRODUCTS

- A. Vault: Knox Box; Series 3200 heavy duty recessed vault.
  - 1. Mounting: Provide 3200 RMK recessed mounting kit.
- B. Padlock: Knox Box; Model 3772 Shrouded Exterior.

#### **PART 3 - EXECUTION**

##### 3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Beginning of execution will constitute acceptance of existing conditions.

##### 3.2 PREPARATION

- A. Prepare substrate surfaces as recommended by manufacturer.

##### 3.3 INSTALLATION

- A. Install using skilled workers in accordance with manufacturer's published instructions and recommendations.

##### 3.4 ADJUSTING

- A. Adjust and fit items to be flush with adjacent construction.
- B. Fasten or adhere for tight connections and joints.

**END OF SECTION**

## SECTION 10 43 13

### EMERGENCY AID CABINETS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Automated external defibrillator (AED) cabinets and equipment.

##### 1.2 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for AED cabinets.
  - 1. Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
  - 2. Show location of knockouts for conduit and wiring.
- B. Samples for Verification: For each type of exposed factory-applied color finish required for AED cabinets, prepared on Samples of size indicated below.
  - 1. Size: 6 by 6 inches square.
- C. Maintenance Data: For AED cabinets to include in maintenance manuals.

##### 1.3 QUALITY ASSURANCE

- A. Fire-Rated AED Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

##### 1.4 COORDINATION

- A. Coordinate size of AED cabinets to ensure that type and size of defibrillators to be provided by the Authority are accommodated.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B.

##### 2.2 AUTOMATED EXTERNAL DEFIBRILLATOR (AED) CABINET

- A. Basis-of-Design Product:
  - 1. The design for AED cabinets is based on AED LifeStart Series by JL Industries, Inc., Model 1435F12 for use in non-fire-rated partitions, and Model 1435F12-FX for use in fire-rated partitions.
  - 2. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer including but not limited to the following:
    - a. Larsens.
    - b. Potter-Roemer.
- B. Cabinet Type: Suitable for automated external defibrillator.

##### 2.3 AUTOMATED EXTERNAL DEFIBRILLATOR

- A. Provide on site automated external defibrillator unit.
  - 1. Basis-of-Design Product: Philips Heart Start OnSite AED Package
- B. Cabinet Construction: Non-rated and 2-hour fire rated, as required to match rating of wall in which cabinet is located.
- C. Cabinet Material: Enameled-steel sheet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
  - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend) of 1/4 to 5/16 inch.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.

- G. Door Style: Fully-glazed panel with frame.
- H. Door Glazing: Acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
  - 1. Provide projecting door pull and friction latch.
  - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
  - 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
    - a. Identify each cabinet with the words "EMERGENCY DEFIBRILLATOR."
      - 1) Location: Applied to cabinet glazing.
      - 2) Application Process: Silk-screened, or decals with clear background.
      - 3) Lettering Color: Black.
      - 4) Orientation: Horizontal.
- K. Finishes:
  - 1. Manufacturer's standard baked-enamel paint for interior of cabinet.

#### 2.4 FABRICATION

- A. AED Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
  - 1. Weld joints and grind smooth.
  - 2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material.
    - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
  - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

#### 2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish cabinets after assembly.

#### 2.6 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.
- B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

#### 2.7 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.
  - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Bright, Directional Polish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Prepare recesses for AED cabinets as required by type and size of cabinet and trim style.

#### **3.3 INSTALLATION**

- A. Install AED cabinets in locations and at mounting heights indicated on Drawings. Fasten cabinets to structure, square and plumb.

#### **3.4 INSTALLATION OF FIRE-RATED CABINETS**

- A. Install cabinet with not more than 1/16-inch tolerance between conduit OD and knockout OD. Center conduit within knockout.
- B. Seal through penetrations with firestopping sealant as specified in Division 07 Section "Penetration Firestopping."

#### **3.5 ADJUSTING AND CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by cabinet manufacturer.
- E. Replace cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**



## SECTION 10 44 13

### FIRE PROTECTION CABINETS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fire-protection cabinets for the following:
    - a. Portable fire extinguisher.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

##### 1.3 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Babcock-Davis.
  - 2. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - 3. Larsens Manufacturing Company.
  - 4. Nystrom, Inc.
  - 5. Potter Roemer LLC.
  - 6. Strike First Corporation of America (The).

##### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

##### 2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Babcock-Davis.
    - b. JL Industries, Inc.
    - c. Larsens Manufacturing Company.
    - d. Nystrom, Inc.
  - 2. Basis-of-Design Products: As scheduled.

- B. Cabinet Construction: Nonrated and rated to match adjacent wall construction.
    - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.
  - C. Cabinet Material: Cold-rolled steel sheet.
  - D. Recessed Cabinet, Where Indicated:
    - 1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.
    - 2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
    - 3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  - E. Semirecessed Cabinet, Where Indicated: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
    - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
    - 2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
  - F. Cabinet Trim Material: Same material and finish as door.
  - G. Door Material: Steel sheet and stainless-steel sheet, where indicated.
  - H. Door Style: Vertical duo panel with frame.
  - I. Door Glazing: Tempered float glass (clear).
  - J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
    - 1. Provide projecting door pull and friction latch.
    - 2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.
  - K. Accessories:
    - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
    - 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
    - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
      - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
        - 1) Location: Applied to cabinet door.
        - 2) Application Process: Pressure-sensitive vinyl letters.
        - 3) Lettering Color: Red.
        - 4) Orientation: Vertical.
  - L. Materials:
    - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
      - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
      - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      - c. Color: As selected by Architect from manufacturer's full range.
    - 2. Stainless Steel: ASTM A 666, Type 304.
      - a. Finish: No. 4 directional satin finish,.
    - 3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
- 2.4 FABRICATION
- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
    - 1. Weld joints and grind smooth.
    - 2. Miter corners and grind smooth.

3. Provide factory-drilled mounting holes.
  4. Prepare doors and frames to receive locks.
  - B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
    1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
    2. Fabricate door frames of one-piece construction with edges flanged.
    3. Miter and weld perimeter door frames and grind smooth.
  - C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
- 2.5 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
  - B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
  - C. Finish fire-protection cabinets after assembly.
  - D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

#### 3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
  1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
  1. Apply vinyl lettering at locations indicated.

#### 3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**

## SECTION 10 44 16

### FIRE EXTINGUISHERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

##### 1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

##### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

##### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
    - a. Babcock-Davis.
    - b. Amerex Corporation.
    - c. Brooks Equipment Co., Inc.
    - d. Buckeye Fire Equipment Co.
    - e. Fire-End & Croker Corporation.
  - 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
  - 3. Valves: Manufacturer's standard.

4. Handles and Levers: Manufacturer's standard.
  5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- 2.3 MOUNTING BRACKETS
- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

### **PART 3 - EXECUTION**

- 3.1 EXAMINATION
- A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 INSTALLATION
- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
1. Mounting Brackets: Top of fire extinguisher to be at height to meet requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

**END OF SECTION**

## SECTION 11 13 13

### LOADING DOCK BUMPERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes loading dock bumpers.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of loading dock bumper.
- B. Shop Drawings: For dock bumpers. Include plans, elevations, sections, and attachment details.

#### PART 2 - PRODUCTS

##### 2.1 LOADING DOCK BUMPERS

- A. General: Surface-mounted bumpers; of type, size, and construction indicated; designed to absorb kinetic energy and minimize damage to loading dock structure.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Floor Products Company, Inc.
    - b. Beacon Industries, Inc.
    - c. Chalfant Sewing Fabricators, Inc.
    - d. Durable Corporation.
    - e. Hugger Dock Equipment Company; Columbus Foam Products, Inc.
    - f. Kelley; An Entrematic brand.
    - g. Pioneer Dock Equipment.
    - h. Rite-Hite Corporation.
    - i. Rotary Products Inc.
    - j. Serco; An Entrematic brand.
    - k. Super Seal Mfg. Ltd.
    - l. Vestil Manufacturing Company.
  - 2. Rubber Dock Bumper Basis-of-Design Product: Beacon Industries, Inc.; Horizontal Laminated Bumpers, Model 1014-4.5.
    - a. Height: 10 inches.
    - b. Width: 14 inches.
  - 3. Extruded Dock Bumper Basis-of-Design Product: Beacon Industries, Inc.; Model BBS-30.
    - a. Height: 30 inches.
    - b. Width: 5-1/2 inches.
    - c. Projection: 1-1/4 inches.
  - 4. Source Limitations: Obtain from single source from single manufacturer.
- B. Anchorage Devices: Galvanized-steel anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plates, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329/F 2329M.
- C. Materials: ASTM 36/A 36M for steel plates, shapes, and bars. Hot-dip galvanize according to ASTM A 123/A 123M.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Loading Dock Bumpers: Attach loading dock bumpers to face of loading dock in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
  - 1. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded-steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded-steel plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.

3.3 ADJUSTING

- A. After completing installation of exposed, factory-finished dock bumpers, inspect exposed finishes and repair damaged finishes.

**END OF SECTION**

## SECTION 111319

### STATIONARY LOADING DOCK EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Recessed loading dock levelers.

##### 1.2 DEFINITIONS

- A. Operating Range: Maximum amount of travel above and below the loading dock level.
- B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

##### 1.3 COORDINATION

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation
- B. Coordinate installation of cast-in-place items. Furnish setting drawings and templates.
- C. Electrical System Roughing-in: Coordinate layout and installation of loading dock equipment with connections to power supplies and interlocked equipment.

##### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
  - 2. Review sequence of operation for each type of loading dock equipment.
  - 3. Review coordination of interlocked equipment specified in this Section and elsewhere.
  - 4. Review required testing, inspecting, and certifying procedures.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For stationary loading dock equipment.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and each field connection.
  - 3. Include diagrams for power, signal, and control wiring.

##### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.
  - 1. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity based on comprehensive testing within last two years of current products.
  - 2. Submittal Form: According to MH 30.1.
- D. Sample Warranty: For manufacturer's special warranty.



1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including recessed pit dimensions, by field measurements before fabrication.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
    - b. Faulty operation of operators, control system, or hardware.
    - c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch (6 mm) between deck supports.
    - d. Hydraulic system failures including failure of hydraulic seals and cylinders.
  2. Warranty Period for Structural Assembly: 10years from date of Substantial Completion.
  3. Warranty Period for Hydraulic System: Five years from date of Substantial Completion.
  4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

**PART 2 - PRODUCTS**

2.1 RECESSED LOADING DOCK LEVELERS

- A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Beacon Industries, Inc.
    - b. Blue Giant Equipment Corporation.
    - c. Kelley; An Entrematic brand.
    - d. Rite-Hite Corporation.
    - e. Serco; An Entrematic brand.
    - f. Vestil Manufacturing Company.
  2. Basis-of-Design Product: Blue Giant Equipment Corporation; Hydraulic Dock Leveler.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.
- D. Rated Capacity: Capable of supporting total gross load of 20,000 (9072) lb (kg) without permanent deflection or distortion.
- E. Platform: Not less than 3/16- (5-) inch- (mm-) thick, nonskid steel plate.
1. Platform Size: 6 feet 6 inches by 6 feet.
  2. Frame: Manufacturer's standard.
  3. Toe Guards: Equip open sides of dock leveler over range indicated with steel toe guards.
    - a. Toe-Guard Range: Entire upper operating range.

- F. Hinged Lip: Not less than 1/2- (13-) inch- (mm-) thick, nonskid steel plate.
  - 1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube and grease fittings, with gussets on lip and ramp for support.
  - 2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.
- G. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.
  - 1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:
    - a. Above Adjoining Platform: 12 inches (305 mm).
    - b. Below Adjoining Platform: 12 inches (305 mm).
  - 2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
  - 3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches (102 mm) over width of ramp.
  - 4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.
    - a. Length of Lip Extension: Not less than 12 inches (305 mm) from face of dock bumpers and not less than 18 inches (457 mm) measured from ramp edge.
  - 5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
  - 6. Interlock: Leveler does not operate while overhead door is in closed position or leveler night lock is engaged.
- H. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches (76 mm).
  - 1. Remote-Control Station with Emergency Stop: Weatherproof multibutton control station with an UP button of the constant-pressure type and an emergency STOP button of the momentary-contact type, enclosed in NEMA ICS 6, Type 4 box. Ramp raises by depressing and holding UP button; ramp lowers at a controlled rate by releasing UP button. Ramp movement stops, regardless of position of ramp or lip, by depressing STOP button. Normal operation resumes by engaging a manual reset button or by pulling out STOP button.
    - a. Dual-Panel Control Station: Remote-control station for operating side-by-side dock levelers.
    - b. Master Panel: Control panel with integral fused disconnecting means for operating dock leveler, dock door, and truck restraints.
  - 2. Independent Lip Operation: Electric-powered hydraulic raising and hydraulic lowering of lip, controlled independent of raising and lowering of ramp.
- I. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.
  - 1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
  - 2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.
- J. Materials:
  - 1. Steel Plates, Shapes, and Bars: ASTM 36/A 36M.
  - 2. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from steel plate complying with ASTM A 572/A 572M, Grade 55 (380).
  - 3. Steel Tubing: ASTM A 500/A 500M, cold formed.
  - 4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- K. Dock-Leveler Finish: Manufacturer's standard prime-paint or baked-on factory finish.
  - 1. Toe Guards: Baked-on factory finish.

- L. Accessories:
  - 1. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming spray zinc metallized steel form system for poured-in-place construction of concrete pit.
  - 2. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
  - 3. Side and rear weatherseals.

## 2.2 FINISH REQUIREMENTS

- A. Finish loading dock equipment after assembly and testing.
- B. Hot-Dip Galvanizing: Comply with the following:
  - 1. ASTM A 123/A 123M for iron and steel loading dock equipment.
  - 2. ASTM A 153/A 153M or ASTM F 2329/F 2329M for iron and steel hardware for loading dock equipment.
- C. Spray Zinc Metallizing: ASTM B 833.
- D. Electrodeposited Zinc Coatings: ASTM B 633.
- E. Steel Prime Paint Finish: Clean, pretreat, and apply manufacturer's standard primer.
- F. Baked-on Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
  - 1. Color: As selected by Architect from manufacturer's full range.
  - 2. Toe Guards: Paint to comply with ANSI Z535.1.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.
- B. Clean recessed pits of debris.

### 3.3 INSTALLATION, GENERAL

- A. Install loading dock equipment as required for a complete installation.
  - 1. Rough-in electrical connections.

### 3.4 INSTALLATION OF RECESSED LOADING DOCK LEVELERS

- A. Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.

### 3.5 ADJUSTING

- A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.
- B. Test dock levelers for vertical travel and adjust to maintain operating range indicated.
- C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.6 MAINTENANCE SERVICE

- A. Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by skilled employees of loading dock equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

**END OF SECTION**

## SECTION 11 61 13

### NETWORKED LIGHTING CONTROL SYSTEM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes all labor, materials, equipment and services necessary to manufacture and deliver to job site, for installation by Electrical Contractor, a complete Lighting Control System, as shown on the drawings and/or specified herein, including but not limited to the following:
1. Primarily ACN/Ethernet structure
    - a. Mains-fed and feed-through relay panels, as indicated on drawings.
    - b. Ethernet control system equipment rack and contents, including:
      - 1) Ethernet switches
      - 2) DMX splitters with related cabling
      - 3) Interfaces with other building systems as required, such as building automation, A/V controls, fire alarm control panel, and related input/output interfaces
      - 4) Battery back-up
    - c. Signal distribution using Ethernet Taps and other fixed control devices.
    - d. Streaming ACN (sACN) compatible Lighting Control Console and associated equipment.
    - e. Architectural lighting control stations (house light stations), including button stations and network-compatible touchscreen stations.
    - f. Architectural lighting DMX distribution system including UL 924 emergency lighting control overrides (UL 1008 emergency lighting power transfer specified elsewhere).
  2. Design intent - PARADIGM
    - a. Lighting Control System shall manage performance lighting for each space, independently from each other, with the following minimum capabilities:
      - 1) Record presets based on live lighting levels generated by lighting control stations and/or Lighting Control Console(s).
      - 2) Recall presets through user input, timeclock events, occupancy/vacancy sensors, daylight sensors, or external triggers as specified (May include: Building Automation System, Audiovisual System, Fire Alarm, Power Loss, Demand Response / Load Shedding).
      - 3) Manipulate all features of individual architectural lighting fixtures (house lights) and stage lighting fixtures with lighting control station(s) and Lighting Control Console(s).
      - 4) Control equipment can be connected to the network at any Ethernet Tap.
      - 5) Fixtures and devices may be added to the network at any Ethernet Tap. Signal adapters, such as DMX Gateways, may be required to connect fixtures and devices to network.
      - 6) Allow simultaneous control of lighting fixtures by lighting control stations and Lighting Control Console(s), with Owner-defined priority levels for each. Control stations may be locked out during performance conditions.
      - 7) Emergency override of DMX levels when triggered by Fire Alarm.
      - 8) Loss of power phase sense device triggers emergency override of DMX levels.
  3. Design intent - MOSIAC
    - a. Lighting Control System shall manage performance lighting for each space, independently from each other, with the following minimum capabilities:
      - 1) Record presets based on live lighting levels generated by lighting control stations and/or Lighting Control Console(s).
      - 2) Recall presets through user input, timeclock events, occupancy/vacancy sensors, daylight sensors, or external triggers as specified (May include: Building Automation System, Audiovisual System, Fire Alarm, Power Loss, Demand Response / Load Shedding).
      - 3) Able to handle capacities of channels ranging from 5,120 up to more than 50,000.
      - 4) Flexible and advanced software programming to include ability to program effects for architectural lighting fixtures.
      - 5) Manipulate all features of individual architectural lighting fixtures (house lights) and stage lighting fixtures with lighting control station(s) and Lighting Control Console(s).

- 6) Control equipment can be connected to the network at any Ethernet Tap.
- 7) Fixtures and devices may be added to the network at any Ethernet Tap. Signal adapters, such as DMX Gateways, may be required to connect fixtures and devices to network.
- 8) Allow simultaneous control of lighting fixtures by lighting control stations and Lighting Control Console(s), with Owner-defined priority levels for each. Control stations may be locked out during performance conditions.
- 9) Emergency override of DMX levels when triggered by Fire Alarm.
- 10) Loss of power phase sense device triggers emergency override of DMX levels.

## 1.2 MANUFACTURING STANDARDS

- A. Manufacture all work in accordance with the latest editions of applicable publications and standards of the following organizations:
  1. National Electric Code (NEC) and all prevailing local and state regulations including:
    - a. ANSI/NFPA 70: National Electrical Code
  2. Entertainment Services and Technology Association (ESTA) including:
    - a. ANSI/ESTA E1.3-2001(R2021): Lighting Control Systems – 0-10V Analog Control Specification
    - b. ANSI/ESTA E1.11-2008 (R2018): USITT DMX512-A
    - c. ANSI/ESTA E1.17-2015 (R2020): Architecture for Control Networks (ACN)
    - d. ANS/ESTA E1.20-2010: Remote Device Management over USITT DMX512
    - e. ANSI/ESTA E1.27-1-2006 (R2021): Portable Control Cables for DMX512
    - f. ANSI/ESTA E1.27-2-2009 (R2019): Permanently Installed Control Cables for DMX512
    - g. ANSI/ESTA E1.31-2018: ACN transport of DMX512
  3. Occupational Safety & Health Act (OSHA)

## 1.3 SUBMITTALS

- A. Prepare and submit documents for review in accordance with the requirements of the Contract Documents.
- B. Product Data Sheets
  1. For Manufacturer standard panels, enclosures, modules, devices, and other equipment, with options and other variables clearly noted on data sheets.
- C. Shop drawings shall be reviewed by the Architect before fabrication begins.
  - a. Such review does not relieve the Manufacturer of the responsibility of providing equipment in accordance with this Specification.
- D. Shop drawings showing:
  - a. Optical or transformer isolation of all control data lines between dimmer racks, panels, and architectural lighting processor.
  - b. Materials, finishes, metal gauges, overall and detail dimensions, sizes, electrical and mechanical connections, fasteners, welds, provisions for the work of others, and similar information.
  - c. Complete details of equipment, including manufacturer's catalog numbers for components, including complete wiring diagrams.
  2. Any deviation from this Specification shall be clouded and noted in letters a minimum 1/4 inches high.
    - a. In order for a deviation to be considered, it shall upgrade the quality of the equipment or respond to a field condition.
  3. Update reviewed shop drawings to show any changes made during manufacturing and assembly and send to the Architect before the equipment is delivered.
- E. Installation instructions for all equipment
  1. Including, but not limited to, connection diagrams, termination designations, etc.
- F. Coordination Drawings
  1. Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
    - a. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
    - b. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

- G. Operations and Maintenance Manual
    - 1. Not more than 14 days after system checkout is complete, the Manufacturer shall provide the Owner with the following:
      - a. One O&M manual printed hard copy
      - b. Two flash drives of O&M manual documents
      - c. O&M Manuals to include, but not limited to:
        - 1) Copies of all record shop drawings.
        - 2) Catalog cuts of all equipment provided.
        - 3) Recommendations for periodic maintenance.
        - 4) Catalog numbers and manufacturer's names and addresses for perishable items such as pilot lamps and fuses.
        - 5) Diagnostic procedures.
        - 6) Internet address for online access to manuals, product literature and troubleshooting guides.
        - 7) Emergency and normal repair telephone contact sheet for 7-day, 24-hour service.
  - H. Lighting Control Console Manual(s)
    - 1. Provide to the Owner at time of system checkout, one printed hard copy of the User Instruction Manual for each Lighting Control Console type, in a 3-ring binder or similar.
    - 2. Lighting Control Console(s) manual(s) may be requested by the Owner's Representative at a date prior to the system checkout.
- 1.4 PROJECT CONDITIONS
- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
    - 1. Ambient temperature: 0-degrees to 40-degrees C (32-degrees to 104-degrees F)
    - 2. Relative humidity: Maximum 90 percent, non-condensing.
    - 3. Protect Lighting Control System from dust during installation.
- 1.5 COORDINATION
- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
    - 1. Match components and interconnections for optimum performance of lighting control functions.
    - 2. Coordinate lighting controls with BAS if applicable. Design display graphics showing building areas controlled; include the status of lighting controls in each area.
    - 3. Coordinate lighting controls with Audiovisual system if applicable. Program appropriate preset triggers and supply necessary strings to AV contractor.
    - 4. Coordinate lighting controls with Fire Alarm system if applicable.
    - 5. Coordinate lighting controls with other Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.
  - B. Coordinate lighting control loads specified in this Section with components providing overcurrent protection as specified in Division 26 Section "Panelboards."
- 1.6 DELIVERY
- A. If required by the Construction Manager or Electrical Contractor, deliver equipment in a minimum of three separate shipments that shall include:
    - 1. Shipment #1: All items in which conduit is terminated which includes dimmer racks, panels, control station back boxes, etc.
    - 2. Shipment #2: All items in which wiring is terminated including control station faceplates, etc.
    - 3. Shipment #3: All items that are not required until system activation by the Manufacturer's field service representative. This includes dimmer modules, electronics modules, control consoles, gateways, monitors, cables, etc.
  - B. If, through no fault of the Owner, the timely completion of the work of this Section is imperiled, the Lighting Control System Manufacturer shall prevent or minimize any delay by shipping the required product to the job site by air freight, at no additional cost to the Owner.
  - C. Bid price shall include full freight and insurance charges for all items to the job site.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

- B. Source Limitations: Obtain lighting control and power distribution components through one source from a single manufacturer wherever possible. The Integrator shall furnish all network lighting control components as described in the contract document or as required for a complete system regardless of source.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- E. Comply with NFPA 70.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two (2) years.
  - 1. Include 24-hour telephone support with guaranteed callback time of less than one hour.
- B. Upgrade Service: Update software and firmware to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading of software shall include operating systems where applicable. Upgrade shall include new or revised licenses for use of the software.
  - 1. Provide thirty-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.9 MANUFACTURERS RESPONSIBILITIES

- A. Study the contract drawings and specifications with regard to the work as shown and required under this section so as to insure its completeness.
- B. Manufacture and deliver equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether such items are herein specified or indicated.
- C. Prepare and submit complete shop drawings and other submittals according to the requirements set forth in the Contract Documents and this Specification.
- D. Coordinate delivery of all equipment with the Construction Manager and/or Electrical Contractor.
- E. Deliver all material to the job site suitably crated, packed, and protected, and bearing the manufacturer's identification label and the nomenclature of the product(s) found in each carton or crate.

1.10 INTEGRATOR'S RESPONSIBILITIES

- A. Provide equipment listed herein or shown on the drawings for installation by the Electrical Contractor.
- B. Provide services as detailed in this specification.
- C. Coordinate the work of this section with other contractors.
- D. Verify, by field measurement on the job site, all dimensions affecting the work
  - 1. Bring field dimensions which vary from those on the approved shop drawings to the attention of the Architect.
  - 2. If required, obtain a directive from the Architect and Owner regarding corrective measures before the start of fabrication of items affected by the variance.

1.11 WARRANTY

- A. Manufacturer agrees to make all repairs, including replacement of components and parts, made necessary due to defects in design, workmanship, and materials without additional cost to the Owner for a period of two years from the date of acceptance of the completed system.
- B. In the event of a system failure during the warranty period, manufacturer agrees to send to the job the necessary field service technician(s) within twenty-four hours of notification.
  - 1. Technician(s) shall remain on the job until all necessary repairs have been made and the system is operational to the satisfaction of the Owner.

**PART 2 - PRODUCTS**

2.1 LIGHTING CONTROL SYSTEM MANUFACTURERS

- A. Approved manufacturers for the work of this section:
  - 1. Electronic Theatre Controls



Burbank, CA  
(323) 461-0216  
<https://www.etconnect.com/>

- B. Equal Manufacturers:
1. Subject to Division 01 Specifications, other manufacturers may submit for consideration as equal to the design basis manufacturer products.
    - a. Submittals for consideration must show conformance to project Specifications and system design requirements.
  2. Manufacturer: Minimum ten years' experience in manufacture of architectural and theatrical lighting controls.
  3. Final determination of suitability shall be at the discretion of the Specifier

## 2.2 INTEGRATED LIGHTING CONTROL PANELBOARDS (Labeled LCP-##)

- A. General:
1. Up to forty-eight network-controlled motorized circuit breakers.
    - a. UL listed and labeled.
  2. Circuit breakers
    - a. Configured for single or dual pole load control as scheduled.
    - b. Remotely operated by network communication link.
  3. Capable of acting as a standalone lighting control system with the following capabilities:
    - a. Internal Astronomical Time Clock for programmed events.
    - b. Accepts input from external button stations for recall of presets.
    - c. Signal arbitration to prioritize inputs by source (sACN, DMX, Preset Stations, Time Clock, etc).
    - d. Configurable loss-of-signal behavior including 'hold last look' and 'activate preset'.
  4. UL 924 rated input
    - a. For triggering emergency 'panic' preset.
  5. USB port
    - a. For upload of configuration files and firmware updates
- B. Physical:
1. Cabinets and Enclosures
    - a. NEMA 1 enclosure sized to accept required relays.
    - b. Surface mounted cover as required with captive screws in a hinged, lockable configuration.
  2. Interior
    - a. Provided with all internal equipment installed and tested
  3. Panel side-mount enclosure
    - a. Provided with low voltage control interface between network and motorized breakers, compliant with partitioning requirements for separation of line and low voltage.
- C. Electrical:
1. Mains-fed LCP Panelboards shall be equipped with a hydraulic/magnetic full-load-rated main circuit breaker, as noted on each panel's associated Panelboard Schedule on QT series Drawings. AIC rating as specified by Electrical Engineer.
  2. Power Supply
    - a. Transformer assembly with internal overcurrent protection, automatic reset, and metal oxide varistor protection against power line spikes.
  3. Circuit Breakers containing solenoid actuators
    - a. To move poles between open and closed positions.
    - b. Overcurrent conditions shall cause a closed contact to open into 'tripped' position for ready identification of state:
      - 1) Coil:
        - a) Magnetically held, momentary coil activation (50 milliseconds)
        - b) 2.2 VA max per breaker to allow simultaneous or sequenced control of up to 10 breakers per control wire run.
        - c) Split coil – 1/2 for ON, 1/2 for OFF.
      - 2) Power Contacts:
        - a) 20A or 30A tungsten and NEMA electronic ballast rated, as scheduled.
        - b) Rated for 50,000 ON/OFF cycles at full load.
        - c) Support #6 - #14 AWG solid or stranded wire.
        - d) 120V and 277V rated.
        - e) FCC approved for commercial use.

- D. Control Electronics:
  - 1. Network and user interface
    - a. Integral to the panel side enclosure
    - b. Interface for individual control of motorized circuit breakers in panelboard
  - 2. Digital graphical display or network port
    - a. For configuration of network addressing
    - b. Status LEDs to indicate presence of Power and DMX signal.
  - 3. DMX512 interfaces
    - a. Serves as primary integrating means between the rack electronics and the lighting control network, and shall also support remote configuration, file storage, playback, and monitoring capabilities from other devices on the network.
    - b. Include at least one optically isolated DMX512 input and one optically isolated DMX512 output per panel.
  - 4. Ride-through power supply
    - a. To remain energized during short duration loss of power, such as during transfer to backup generator.
  - 5. Furnish 0-10V control interface card where 0-10V loads are indicated on the associated panel schedule.
- E. Basis of Design
  - 1. Basis of Design for Integrated Lighting Control Panelboards:
    - a. SensorIQ, as manufactured by Electronic Theatre Controls

### 2.3 LIGHTING CONTROL RELAY PANELS (Labeled LRP-##)

- A. General:
  - 1. Up to forty-eight network-controlled relays.
    - a. UL listed and labeled.
    - b. Configured for single or dual pole load control as scheduled.
    - c. Remotely operated by network communication link.
  - 2. Capable of acting as a standalone lighting control system with the following capabilities:
    - a. Internal Astronomical Time Clock for programmed events.
    - b. Accepts input from external button stations for recall of presets.
    - c. Signal arbitration to prioritize inputs by source (sACN, DMX, Preset Stations, Time Clock, etc).
    - d. Configurable loss-of-signal behavior including 'hold last look' and 'activate preset'.
  - 3. UL924 rated input
    - a. For triggering emergency 'panic' preset.
  - 4. USB port
    - a. For upload of configuration files and firmware updates.
- B. Physical:
  - 1. Cabinets and Enclosures
    - a. NEMA 1 enclosure sized to accept required relays.
    - b. Surface mounted cover as required with captive screws in a hinged, lockable configuration.
  - 2. Interior
    - a. Provided with installed and tested relays and interface modules.
  - 3. Panel side-mount enclosure
    - a. Provide low voltage control interface between network and relays, compliant with partitioning requirements for separation of line and low voltage.
  - 4. Provide physical separators between relays fed by 120V and 277V circuits, as well as between relays fed by Normal and Emergency circuits, as noted on each panel's associated Relay Panel Schedule on QT series Drawings.
- C. Electrical:
  - 1. Relays:
    - a. Mechanically held latching relays, 20A or 30A tungsten and NEMA electronic ballast rated, as scheduled.
    - b. Rated for 50,000 ON/OFF cycles at full load.
    - c. Support #10 - #14 AWG solid or stranded wire.
    - d. 120V and 277V rated.
    - e. FCC approved for commercial use.
- D. Control Electronics:
  - 1. Network and user interface

2. Digital graphical display interface or by network port
  - a. For configuration of network addressing
3. Status LEDs
  - a. For indicating presence of Power and DMX signal.
4. System network interface
  - a. The primary integrating means between the rack electronics and the lighting control network
  - b. Supports remote configuration, file storage, playback, and monitoring capabilities from other devices on the network
5. DMX512 interface
  - a. At least one optically isolated DMX512 input and one optically isolated DMX512 output per panel.
6. Ride-through power
  - a. To remain energized during short duration loss of power, such as during transfer to backup generator
7. 0-10v control interface card in each panel

E. Basis of Design

1. Basis of Design for Lighting Control Relay Panels shall be:
  - a. Echo Feedthrough, as manufactured by Electronic Theatre Controls

2.4 LIGHTING CONTROL NETWORK AND INTERFACE

A. General:

1. Furnish and install a complete lighting control network system capable of supporting the following:
  - a. Specified dimmer racks, panelboards, and relay panels
  - b. Stage Lighting Control Console(s)
  - c. Architectural control stations
  - d. Occupancy/Vacancy sensors
  - e. Daylight sensors
  - f. Time and calendar schedules
  - g. Related network devices indicated on the drawings and in this Specification
2. Category 5e Ethernet distribution
  - a. To communicate between Lighting Control Console(s), dimmer racks, panelboards, relay panels, gateways, sensors, computers, etc.
3. Manufacturer specified wiring and topology for communication with control stations, sensor devices and relay panels.

B. Network Components:

1. Control Processors:
  - a. Furnish architectural processors as required to interface dimmer rack, lighting control relay panels, control stations, sensors, system I/O contacts, and any appurtenant devices or equipment required for system to function fully as intended.
    - 1) Provide necessary programming interface for setup and configuration of system and system components.
  - b. Include one backup processor, which may be used as a replacement processor for any venue in the building.
  - c. Include one backup station power module, which may be used as a replacement for any venue in the building.
2. Basis of Design for Auditorium: ETC – Mosaic Show Controller and Paradigm
  - a. Battery-backed real-time, astronomical, and lunar time clock.
  - b. Supports sACN, KiNet, Pathport, Art-Net and digital video.
    - 1) Supports triggering from sACN and Artnet level input.
  - c. Simple integration with other Mosaic devices for large systems
  - d. Supports conditional logic and scripting for integration.
  - e. Ethernet integration with Mosaic RIO modules, Button Stations, and other Mosaic Show Controllers.
  - f. DVI video (HDMI compatible) input for live video at up to 1080p30 with support for all major formats including H.264/ MPEG-4 AVC, MJPEG and QuickTime.
  - g. Triggering and show-control integration using Ethernet, RS232/485, DMX, MIDI, digital/analog inputs, and optional remote devices.
  - h. Local User Interface
  - i. Web User Interface

3. Ethernet switches and patch bays:
  - a. Ethernet Switches in port quantities as required for devices in system plus 25% spare for future expansion at each rack location.
  - b. Patch bays in port quantities as required for devices in system plus 25% spare for future expansion at each rack location.
4. DMX signal splitters:
  - a. ANSI/USITT E1.1-2008 compliant DMX512 opto-isolating splitters, in quantity and configuration of inputs and outputs as required for system.
  - b. All DMX signal cables terminating at the splitter location shall be outfitted with 5-pin XLR connectors or RJ45 connectors as necessary to permit user patching where required. This includes signals to Ethernet-to-DMX gateway node receptacles, dimmers, and relay panels.
5. Equipment Racks:
  - a. Wall or floor mounted 19-inch equipment racks with mounting rails, hinged locking door, and sized to accommodate all required processing equipment including that indicated above.
    - 1) Furnish in quantities shown on drawings plus any additional required for complete system.
  - b. Minimum of one four-space contiguous blank section with cover plate for future equipment addition.
  - c. Each rack shall be furnished with a three-space pull out drawer for storage of manuals, patch cabling, and user notes.
  - d. Racks shall be Middle Atlantic SR series, EWR series or equal.
  - e. Racks shall be furnished with an uninterruptible power supply (UPS) battery backup.
  - f. Coordinate electrical power connections for rack contents.
6. Ethernet cabling:
  - a. Ethernet cabling used in theatrical lighting control network shall have the following properties:
    - 1) Comply with NEMA WC-63.1 Category 5e, UL verified.
    - 2) Comply with TIA 568.C.2.
    - 3) Outer jacket shall be purple in color.
  - b. Furnish and install RJ45 Category 5e patch cables as necessary to fully patch between all network switch ports and patch bay ports in each rack location, plus 20% spares.
  - c. Furnish additional RJ45 Category 5e patch cables to allow connection of distributed Ethernet ports to portable Ethernet-to-DMX gateway devices in the performance spaces. Refer to Theatrical Lighting Fixtures and Accessories Schedule on QT series Drawings for lengths and quantities to be furnished.
7. DMX Network Cabling:
  - a. Furnish and install 5-pin XLR M/F DMX jumper patch cables as necessary to fully patch between all DMX splitter ports and DMX patch points, racks, or other DMX devices at equipment racks.
  - b. Furnish additional 5-pin XLR M/F DMX jumper cables to allow connection of DMX node devices to stage lighting fixtures and other DMX-controlled devices in the performance spaces. Refer to Theatrical Lighting Fixtures and Accessories Schedule on QT series Drawings for lengths and quantities to be furnished.
8. Ethernet Taps:
  - a. Location, mounting type, and qty as shown on drawings and schedules
  - b. RJ45 Ethernet connectors, each discretely fed from patch panel, unless otherwise noted.
9. Ethernet-to-DMX Gateways:
  - a. Mounting as shown on Drawings, furnish with necessary hardware.
  - b. Each node with one, two, or four each 5-pin XLR connectors configurable for DMX512 input or output, or for ESTA/ANSI E1.20 two-way communication. Each connector may be addressed to discrete universes.
  - c. Surface mount nodes shall have Ethernet wire feed from patch panel to device.
  - d. Portable nodes shall have one RJ45 Ethernet connection to permit patching into any Ethernet Tap shown on drawings. Each shall be outfitted with Light Source MAB mega clamp or equal aluminum pipe clamp.
  - e. Refer to drawings and schedules for quantity of each node type to be furnished.
10. Input/Output devices for communication with other systems:
  - a. Furnish minimum eight dry contact closures configurable as input or output signals, to connect with fire alarm system, effects controls, shading systems, and future interfaces.

2.5 LIGHTING CONTROL NETWORK HARDWARE

1. D.I.N. Enclosure containing the following:
  - a. DMX Scene Controller
    - 1) Preset record based on live DMX levels (min. 32 presets)
    - 2) Preset recall (min. 32 presets) with adjustable fade times
  - b. DMX splitters with related cabling
  - c. Time Clock
  - d. Interfaces with other building systems as required, such as building automation, A/V controls, fire alarm control panel, and related input/output interfaces.
    - 1) Furnish minimum eight dry contact closures configurable as input or output signals
  - e. Battery backup

2.6 DMX IN/OUT PLATES

- A. General
  1. DMX connector plates in surface or recessed backboxes, provided by Manufacturer and installed by Electrical Contractor
  2. Refer drawings for quantity, configuration, and placement.
- B. Connectors
  1. DMX-IN: 5-pin XLR connector(s), male
  2. DMX-OUT: 5-pin XLR connector(s), female
- C. Labeling
  1. DMX devices shall have Control Device Number (i.e. 'DMX-5') clearly indicated on the faceplate.
    - a. Minimum 1/4-inch tall white on black characters
    - b. Center above control port(s).
    - c. Match faceplate labels to those on the QT series Drawings. Verify in Shop Drawings.
  2. Furnish and install removable adhesive labels for each Theatrical Control Device back box and rear of faceplate, indicating the Control Device Number (i.e. 'DMX-5') and serial code to facilitate programming and commissioning.

2.7 STAGE LIGHTING CONTROL CONSOLES

- A. General
  1. For each console, furnish all power and interface devices, cabling, and accessories necessary for a fully functioning system.
- B. Console
  1. Basis of Design: ETC – Ion Xe 20
  2. Performance Requirements:
    - a. Min. 19-inch color multi-touch touchscreen
    - b. Min. (20) Channel / Playback faders
    - c. Min. Two (2) DMX/RDM port (1024 outputs)
    - d. Min. Two (2) USB ports
    - e. 25 GB onboard storage for show files
  3. Accessories:
    - a. (1) standalone LED gooseneck task light
    - b. (1) Dust Cover
    - c. (1) 15-foot DMX 5-pin XLR patch cable
    - d. (1) Case

2.8 ARCHITECTURAL LIGHTING CONTROL STATIONS (HOUSE LIGHT STATIONS)

- A. General
  1. Stations shall serve as user interface to recall and manipulate common room lighting presets via the lighting control network. Stations shall occur in the following styles:
    - a. Fixed Touchscreen stations
      - 1) Station programming shall support discrete screen shots configurable for preset recall, virtual faders, clock and time scheduling functions, dynamic color wheel for LED fixture color selection.
      - 2) Station shall be configured with general lighting on/off and code lockout for additional features on home page.
      - 3) Design display graphics showing stage areas controlled; include the status of lighting controls in each area.

- b. Portable Touchscreen stations
  - 1) Handheld portable P.O.E. touchscreen with equivalent capabilities to Fixed Touchscreen stations.
  - 2) Device shall connect to any Ethernet port for control of the Lighting Network.
- c.
- d. Preset stations with buttons and faders
  - 1) Preset stations shall have an LED constantly illuminated when the system is powered.
  - 2) When a preset is activated, LED shall be illuminated on every preset control station capable of controlling that preset.
  - 3) Control station faceplates shall be in color shown on the drawings with engravings as noted.
  - 4) Preset/Fader stations shall fit in an industry standard back box furnished by Electrical Contractor and shall have faceplates with no visible fasteners.
  - 5) Faceplates shall be engraved with custom labeling as determined by Owner and/or Specifier during shop drawing review.
  - 6) Each preset and fader can be discretely programmed for scene recall, timed fades, on/off toggle, pile-on, and macro sequences, as indicated on drawings and by Owner and/or Specifier during system commissioning.
  - 7) Stations shall operate on low voltage network bus as specified by Manufacturer, or on Category 5e cable with P.O.E., and shall be programmable via this network.

## 2.9 ARCHITECTURAL LIGHTING DMX DISTRIBUTION SYSTEM

- A. Provide bi-directional DMX repeater(s) as required with sufficient DMX outputs for control of DMX enabled architectural lighting fixtures.
- B. Provide emergency DMX bypass device(s) as noted on drawings, for lighting control override during loss of power or emergency evacuations. Bypass device(s) shall receive the following feeds:
  - 1. Panic signal from Fire Alarm Control Panel
  - 2. Loss of power signal from Emergency Bypass Detection Kit with power sense feed

## PART 3 - EXECUTION

### 3.1 SYSTEM INTEGRATOR

- A. Approved Integrators for the Work of this Section include:
  - 1. 4 Wall Entertainment  
Houston, TX  
(281) 209-1944  
<https://www.4wall.com/>
  - 2. Clearwing Systems Integration  
Denver, CO  
(303) 232-3540  
<https://www.clearwing.com/>
  - 3. Production Resource Group  
Dallas, TX  
(214) 630-1963  
<http://www.prg.com>
- B. Equal Integrators:
  - 1. Minimum five years' experience with supply, installation, commissioning, and integration of theatrical and architectural lighting control systems
  - 2. At least ten recent projects of similar scope and characteristics to those specified herein
- C. System Integrator shall be responsible for scope outlined in this Specification and for the following related Specification sections:
  - 1. 116116 – Theatrical Wiring Devices
  - 2. 116119 – Theatrical Lighting Fixtures and Accessories
- D. System integrator shall be responsible for providing factory authorized personnel for system startup, programming, commissioning, and Owner training.

### 3.2 EXECUTION

- A. Verify that surfaces are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Install in accordance with manufacturer's instructions and approved shop drawings.
- E. All wiring shall be installed in conduit.
- F. Live test all branch load circuits before connecting the loads to the lighting control panels

### 3.3 SUPPORT SERVICES BY FACTORY-AUTHORIZED TECHNICIAN

- A. System Startup
  - 1. Upon completion of installation, Contractor shall notify the Manufacturer that the system is ready for formal checkout and programming.
    - a. The Lighting Control System stays powerless unless specifically authorized by written instructions from the manufacturer.
  - 2. Provide Factory-Authorized Technician to confirm proper installation and operation of all system components
- B. Testing by Factory-Authorized Technician
  - 1. Perform complete functional test of the system, including the following:
    - a. Test all loads live for continuity and freedom from defects
    - b. Test all control wiring for continuity and connections
    - c. All continuity tests and repairs must be completed prior to energizing the system components.
- C. Repairs
  - 1. Contractor shall be responsible for correction of any improper wiring or component installation as identified by the Factory-Authorized Technician during testing.
  - 2. Contractor shall be responsible for any return visits by Factory-Authorized Technician resulting from lack of system readiness for checkout or from any incomplete or incorrect wiring or installation.
- D. Initial Programming by Factory-Authorized Technician
  - 1. Programming of initial button assignments, touch screen page layouts, normal and emergency presets, control priorities, sensor settings, time clock events, etc.
  - 2. All final decisions regarding programming shall be at the direction of the Owner.

### 3.4 COMMISSIONING AND OWNER TRAINING

- A. General
  - 1. Factory-Authorized Technician shall perform Owner Training.
  - 2. Class size is limited to twelve participants
  - 3. Schedule instruction with the Owner's designated representatives.
  - 4. Provide all O&M materials, as designated in this Specification, at the time of training.
  - 5. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
  - 6. At Owner's discretion, instruction may occur in multiple time blocks.
  - 7. Provide the Owner with written documentation upon completion of training.
    - a. Form to include:
      - 1) The date, time, and location of training.
      - 2) Name, title, company and signature of trainer.
      - 3) Name, title, and signature of all participants.
      - 4) Topics covered at training.
    - b. If training is non-continuous, provide one form for each training segment.
- B. Provide up to 12 hours of Owner training to include the following:
  - 1. Minimum of three separate training sessions with Owner, as follows:
    - a. First session shall occur at conclusion of startup and system commissioning and shall include four hours training time with Owner representatives. Include the following general subjects, but tailor to the Owner's preference at time of training:
      - 1) General system overview.

- 2) Routine care and maintenance.
- 3) Lighting Control Station operation and configuration, including review of initial programming of presets.
- 4) Lighting Control Console introduction and basic programming
- 5) Review of warranty and software updates
- b. Second session shall occur no less than two weeks following substantial completion, but within one month of initial training. This session shall include up to an additional four hours training time with Owner representatives. Include the following general subjects, but tailor to the Owner's preference at time of training:
  - 1) In-depth Lighting Control Console operation and programming appropriate to the level of the users.
  - 2) Lighting Control Station preset review and adjustment to reflect operational needs.
  - 3) Other review as requested by Owner.
  - 4) Introduction to online training resources.
- c. Third session shall occur no less that one month after the second session, but within the first year.
  - 1) More advanced Lighting Control Console operation and programming appropriate to the level of the users.
  - 2) Lighting Control Station preset review and adjustment to reflect operational needs.
  - 3) Other review as requested by Owner.
  - 4) Review of online training resources.
2. Set specific agenda for each session in advance.
3. Training may be video and audio recorded by the Owner at the Owner's expense.

END OF SECTION 11 61 13



## SECTION 11 61 16

### THEATRICAL LIGHTING WIRING DEVICES

#### PART 1 - GENERAL

##### 1.1 WORK OF THIS SECTION

- A. This Section includes all labor, materials, equipment and services necessary to manufacture and deliver to job site, for installation by Electrical Contractor, theatrical wiring devices, including back boxes, as shown on the drawings and/or specified herein, including but not limited to the following:
  - 1. Flush-Mount receptacle boxes
  - 2. Surface mount receptacle boxes
  - 3. Pipe mount receptacle boxes
  - 4. Pipe batten mount connector strips with multicable
  - 5. Pipe batten mount connector strips with cable management
  - 6. Surface mount multicable junction boxes
  - 7. Multicables
- B. Installation of equipment shall be by Electrical Contractor

##### 1.2 SUBSTITUTIONS

- A. Substitutions are allowed when the substitution improves the quality, decrease installation time, or reduce cost.
  - 1. Submit a proposal that clearly outlines construction features of the product so that true and accurate comparisons may be made.
    - a. Samples of the proposed substitution item/s may be requested by the Architect and/or Owner for evaluation.
- B. No product bid which deviates from the details of the Construction Documents will be considered unless such deviation has been approved in advance by the Architect

##### 1.3 SUBMITTALS

- A. Prepare and submit complete shop drawings according to requirements set forth in the Contract Documents.
- B. Show bussing for each outlet box and shall utilize the exact circuit numbering method detailed in the shop drawings
- C. Furnish catalog cuts, drawings, and/or descriptive material of catalog items as requested by the Architect.
- D. Furnish all of the above for review by the Architect prior to commencing any work.
  - 1. Such review does not relieve the Manufacturer of the responsibility of providing equipment in accordance with this Specification.
- E. Any deviation from this Specification is to be clouded and noted in letters a minimum 1/4 inches high.
  - 1. In order for a deviation to be considered it shall upgrade the quality of the equipment or respond to a field condition.

##### 1.4 MANUFACTURING STANDARDS

- A. All work shall be manufactured in accordance with the latest editions of applicable publications and standards of the following organizations:
  - 1. National Electric Code (NEC) and all prevailing local and state regulations
  - 2. National Electrical Manufacturers Association (NEMA)
  - 3. Occupational Safety & Health Act (OSHA)
- B. All applicable products shall bear label of Underwriters Laboratories (UL).
- C. All receptacle, back box, junction box, face plate, and connector construction:
  - 1. Minimum 18-gauge steel
  - 2. Color: Black

1.5 MANUFACTURER'S RESPONSIBILITIES

- A. Study the contract drawings and specifications with regard to the work as shown and required under this section so as to insure its completeness.
- B. Manufacture and deliver equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.
- C. Test all equipment thoroughly in shop prior to shipment to ensure mechanical and electrical integrity

1.6 LABELING

- A. Permanently identify all theatrical wiring devices with means and methods as noted on the drawings and elsewhere in this specification.
- B. Each faceplate and back box shall be tagged with a removable label identifying the WD box "number"

1.7 DELIVERY

- A. Delivery per the Construction Documents.
- B. The Manufacturer shall coordinate delivery of all equipment with the General Contractor and/or Electrical Contractor.
- C. Manufacturer shall, if requested by the General Contractor and/or Electrical Contractor, deliver theatrical wiring devices items in the following two (2) separate shipments:
  - 1. Shipment #1: Back boxes for all theatrical wiring device items so that the Electrical Contractor may terminate all conduit.
  - 2. Shipment #2: Faceplates for all theatrical wiring device items.
  - 3. Theatrical Wiring Device Manufacturer shall notify the Construction Manager and/or Electrical Contractor 24 hours prior to delivery of equipment.
- D. Deliver all material to the job site suitably crated, packed, and protected.
  - 1. Crate/Carbons clearly marked on the outside with the Manufacturer's identification label and the nomenclature of the product contained within.

1.8 WARRANTY

- A. The Manufacturer shall assure that all equipment is provided free of defects in materials and workmanship and shall provide a warranty under this contract for a period of two years from the date of final acceptance.
- B. During the warranty period, repair or replacement of defective materials and/or repair of faulty workmanship shall be provided, at no cost to the Owner, within ten days written notice of the defect(s).

**PART 2 - PRODUCTS**

2.1 THEATRICAL WIRING DEVICE MANUFACTURERS

- A. Manufacturers for work of this section include:
  - 1. Altman Lighting  
Denver, CO  
1-303-500-7072  
<https://www.altmanlighting.com/>
  - 2. Electronic Theatre Controls (ETC)  
Austin, TX  
(512) 836-2242  
<https://www.etconnect.com/>
  - 3. SSRC  
Duncan, SC  
(864) 848-9770  
<https://www.ssrconline.com/>
- B. Equal Manufacturers:
  - 1. Subject to Division 01 Specifications, other manufacturers may submit for consideration as equal to the design basis manufacturer products.
    - a. Submittals for consideration must show conformance to project Specifications
  - 2. Manufacturer: Minimum ten (10) years' experience in manufacture of theatrical wiring devices.

3. Final determination of suitability shall be at the discretion of the Specifier

## 2.2 FLUSH AND SURFACE MOUNT RECEPTACLE BOXES

- A. Provide flush and surface mount receptacle boxes and RJ45 ports as listed herein and shown on the drawings.
- B. Face Plates:
  1. Steel
  2. Mounting holes on face plate.
  3. Color as scheduled
  4. Circuit numbers engraved directly into a black lamicoïd or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
    - a. Text Height: 1/4 inch
    - b. Color: White on black
    - c. Verify circuit numbers in shop drawings
- C. Buss bars, for each receptacle plate:
  1. Solid Copper
  2. Adjacent neutral pairs for each circuit
  3. Adjacent hot leg pairs for each circuit
  4. Grounds for each receptacle plate
- D. Prewire boxes with 125-Celsius high temperature wire to molded barrier terminal blocks.
- E. Connectors:
  1. Standard Edison parallel blade U ground connectors as shown on the drawings.
  2. Mount at spacing listed herein or as shown on the drawings
- F. Mounting:
  1. Mount back box per code requirements

## 2.3 PIPE MOUNTED RECEPTACLE BOXES

- A. Provide pipe mount receptacle boxes and RJ45 ports as listed herein and shown on the drawings.
- B. Face Plates:
  1. Steel
  2. Mounting holes on face plate.
  3. Color as scheduled
  4. Circuit numbers engraved directly into a black lamicoïd or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
    - a. Text Height: 1/4 inch
    - b. Color: White on black
    - c. Verify circuit numbers in shop drawings
- C. Buss bars, for each receptacle plate:
  1. Solid copper
  2. Adjacent neutral pairs for each circuit
  3. Adjacent hot leg pairs for each circuit
  4. Grounds for each receptacle plate
- D. Boxes shall be prewired with 125-Celsius high temperature wire to molded barrier terminal blocks.
- E. Connectors:
  1. Standard Edison parallel blade U ground connectors
  2. Mount at spacing listed herein or as shown on the drawings
- F. Mounting:
  1. Boxes attach to battens with U-bolts
- G. Include back boxes
  1. Label with circuit numbers to avoid mismatches in the field

## 2.4 PIPE MOUNT CONNECTOR STRIPS

- A. Provide pipe mount continuous connector strips with flush mounted receptacles and RJ45 ports as listed herein and as shown on the drawings.
  1. For each connector strip, provide mounting brackets (hangers) and associated hardware that are designed to mount the connector strip to an 1-1/2-inch NPS steel pipe railing.

- B. Face Plates:
    - 1. Steel
    - 2. Mounting holes on face plate.
    - 3. Color as scheduled
    - 4. Circuit numbers engraved directly into a black lamicoïd or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
      - a. Text Height: 1/4 inch
      - b. Color: White on black
      - c. Verify circuit numbers in shop drawings
  - C. Connectors:
    - 1. Standard Edison parallel blade U ground connectors
    - 2. Mount at spacing listed herein or as shown on the drawings
  - D. Buss bars, for each receptacle plate:
    - 1. Solid copper
    - 2. Adjacent neutral pairs for each circuit
    - 3. Adjacent hot leg pairs for each circuit
    - 4. Grounds for each receptacle plate
  - E. Pre-wire connector strip with 125-Celsius high temperature wire to double sided, numbered molded barrier terminal strips at end of each connector strip.
    - 1. Terminate all circuit wiring on one side of the terminal strip.
    - 2. Other side is reserved for load wiring termination by Electrical Contractor.
  - F. Ship connector strips in segments folded over one another with the internal wiring intact when strips are too long.
    - 1. Grind inside edges smooth to prevent damage to internal wiring
    - 2. Provide splice hardware as required
- 2.5 PIPE BATTEN MOUNT CONNECTOR STRIPS WITH MULTICABLES
- A. Provide pipe batten mount continuous connector strips with flush mounted receptacles and RJ45 ports as listed herein and as shown on the drawings.
    - 1. For each connector strip, provide mounting brackets and associated hardware as required to hang the connector strip on a stage rigging system 1-1/2-inch NPS steel pipe batten.
  - B. Face Plates:
    - 1. Steel
    - 2. Mounting holes on face plate.
    - 3. Color as scheduled
    - 4. Circuit numbers engraved directly into a black lamicoïd or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
      - a. Text Height: 2 inches maximum
      - b. Color: White on black
      - c. Verify circuit numbers in shop drawings
  - C. Connector strip construction:
    - 1. Stated (1.5 D) steel or min. 1/8-inch aluminum.
  - D. Connectors:
    - 1. Edison parallel blade U ground type flush receptacles
    - 2. Mount at spacing listed herein or as shown on the drawings
  - E. Buss bars, for each receptacle plate:
    - 1. Solid Copper
    - 2. Adjacent neutral pairs for each circuit
    - 3. Adjacent hot leg pairs for each circuit
    - 4. Grounds for each receptacle plate
  - F. Pre-wire connector strip with 125-Celsius high temperature wire to double sided, numbered molded barrier terminal strips at end of each connector strip.
    - 1. Terminate all circuit wiring on one side of the terminal strip.
    - 2. Other side is reserved for load wiring termination by Electrical Contractor.
  - G. Multicables:
    - 1. #12 type SO or SJ with one end factory terminated in the connector strip junction box.
    - 2. Attach a "Kellems Grip" to each multicable at each connector strip.

3. Strip the loose end and tag each conductor with an appropriate circuit number.
  4. Multicable lengths listed herein and/or shown on drawings is from face of connector strip to face of multicable junction box. Increase length as required for internal wiring of junction boxes.
  5. Provide a separate "Kellems Grip" for the loose end of the multicable which shall be attached by the Electrical Contractor in the field.
- H. Ship connector strips in segments folded over one another with the internal wiring intact when strips are too long.
1. Grind inside edges smooth to prevent damage to internal wiring
  2. Provide splice hardware as required
- I. Theatrical Wiring Device manufacturer may propose alternate connector strip quantities and configurations that achieve the required circuit quantities and spacings, subject to approval by Architect and Theatre Consultant.

## 2.6 PIPE BATTEN MOUNT CONNECTOR STRIPS WITH CABLE MANAGEMENT

- A. Provide pipe batten mount continuous connector strips with flush mounted receptacles and RJ45 ports as listed herein and as shown on the drawings.
1. For each connector strip, provide mounting brackets and associated hardware as required to hang the connector strip on a stage rigging system 1-1/2-inch NPS steel pipe batten.
  2. Provide pantograph cable management devices in locations as shown on drawings.
- B. Face Plates:
1. Steel
  2. Mounting holes on face plate.
  3. Color as scheduled
  4. Circuit numbers engraved directly into a black lamicoid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
    - a. Text Height: 2 inches maximum
    - b. Color: White on black
    - c. Verify circuit numbers in shop drawings
- C. Connector strip construction:
1. Stated (1.5 D) steel or min. 1/8-inch aluminum.
- D. Connectors:
1. Standard Edison parallel blade U ground connectors
  2. Mount at spacing listed herein or as shown on the drawings
- E. Pre-wire connector strip with 125-Celsius high temperature wire to double sided, numbered molded barrier terminal strips at end of each connector strip.
1. Terminate all circuit wiring on one side of the terminal strip.
  2. Other side is reserved for load wiring termination by Electrical Contractor.
- F. Pantograph:
1. Located between batten rigging pick-up cables.
  2. Include a horizontal stabilization track and flat multi-cable to provide permanent electrical connection for the stage lighting dimming circuits.
  3. Circuit quantities as scheduled
  4. Network cable as scheduled
  5. Coordinate pantograph gridiron junction box location with Electrical Contractor.
- G. Ship connector strips in segments folded over one another with the internal wiring intact when strips are too long.
1. Grind inside edges smooth to prevent damage to internal wiring
  2. Provide splice hardware as required
- H. Theatrical Wiring Device Manufacturer may propose alternative cable management system subject to review by Architect and Theatre Consultant.

## 2.7 MULTICABLE JUNCTION BOXES

- A. Provide surface mount multicable junction boxes as listed herein and shown on the drawings.
- B. Junction boxes sized as required and with a hinged or removable cover.
1. The front cover of each junction box shall have listed the circuit numbers terminated in that particular junction box.
    - a. Text Height: 1 inch

b. Text Color: White

- C. Provide molded barrier terminal strips with screw lugs labeled with appropriate circuit numbers.
- D. Junction box shall be ready for installation of multi-cables by the Electrical Contractor.

## 2.8 MULTICABLES

- A. Provide 6 circuit, 20A, #12 type SO or SJ multicables in quantities and lengths shown on the drawings.
- B. Connectors:
  - 1. male and female Socapex VSC, 6 circuit, 19 pin, 25A equipped with wire mesh strain reliefs on each multicable
  - 2. Identify circuit numbers on each end of the multicable by minimum 1/2-inch adhesive labels covered with clear shrink tube either on the connector or on the cable, 2 inches from the connector.
- C. Verify lengths prior to fabrication.
- D. Each pigtail shall be type SO cable, 1 foot in length and have a standard theatrical male 2 pin and ground connector.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Verify that equipment is properly wired, terminated, and ready for electrical connection and energization.

### 3.2 PREPARATION

- A. Review equipment submittals prior to installation and electrical rough-in. verify location, size, and type of devices. Coordinate details of equipment connections with supplier and Professional.

### 3.3 INSTALLATION

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment where appropriate

### 3.4 MANUALS

- A. Provide the Owner with one printed hard copy Operations and Maintenance manual as well as the O&M manual in electronic format on two flash drives. Operations and Maintenance Manuals include, but not be limited to the following:
  - 1. Contact name, phone number and e-mail address
  - 2. Record shop drawings
  - 3. Catalogue cuts and complete parts list of equipment installed
  - 4. Recommended maintenance procedures
  - 5. Information identifying fabric manufacturer, type number, color number, weight, width and manufacture date

### 3.5 PROTECTION AND CLEANING

- A. The Supplier is solely and exclusively responsible for the following:
  - 1. Satisfactory installation
  - 2. Furnishing and storing all equipment and tools during the period of installation.
  - 3. Collecting and removing from the job site all packing materials, trash, scrap materials, etc. from these stage lighting fixtures
  - 4. Protection of equipment and/or finished materials provided by other contractors

END OF SECTION 11 61 16

**SECTION 11 61 19**

**STAGE LIGHTING FIXTURES**

**PART 1 - GENERAL**

**1.1 WORK OF THIS SECTION**

- A. All labor, materials, equipment, and services necessary to furnish, for installation by others, the Stage Lighting Fixture package specified herein, including but not limited to, the following:
  - 1. Stage lighting fixtures, lamps and accessories.
  - 2. Hardware and jumper cables.
  - 3. Miscellaneous items.
  - 4. Equipment installation.

**1.2 SUBSTITUTIONS**

- A. Substitutions are allowed when the substitution improves the quality, decrease installation time, or reduce cost.
  - 1. Submit a proposal that clearly outlines construction features of the product so that true and accurate comparisons may be made.
    - a. Samples of the proposed substitution item/s may be requested by the Architect and/or Owner for evaluation.
- B. No product bid which deviates from the details of the Construction Documents will be considered unless such deviation has been approved in advance by the Architect.

**1.3 SUBMITTALS WITH BID**

- A. A list of all items with manufacturer's catalog numbers for each item
- B. A unit price for each item listed per schedule
  - 1. Unit pricing may be used by the Owner to determine the value of any additions to or deletions from the equipment list
  - 2. Failure to provide unit pricing may result in the disqualification of the bid

**1.4 SUBMITTALS**

- A. Supplier shall submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop drawings shall include catalogue cuts of all items listed in the Stage Lighting Fixture & Accessories Schedule for review.
- C. Provide unit pricing for all items listed in the Stage Lighting Fixture & Accessories Schedule

**1.5 STAGE LIGHTING FIXTURE INSTRUCTION**

- A. Stage Lighting Fixture Supplier shall provide Owner's designated representative(s) with up to eight hours of instruction in the configuration, programming, and operation of the LED stage lighting fixtures

**1.6 DELIVERY**

- A. Delivery per the Construction Documents
- B. Include full freight and insurance charges for delivery of all of the equipment to the job site in the bid price.
- C. Supplier shall confirm the delivery dates with the Construction Manager and/or Owner a minimum of thirty days in advance of scheduled delivery
- D. Deliver all material to the job site suitably crated, packed, and protected
  - 1. Crates/Cartons clearly marked on the outside with the manufacturer's identification labels and the nomenclature of the product contained within

1.7 WARRANTY

- A. Assure that this equipment is provided free of defects in materials and workmanship and provide a warranty under this contract agreeing to make all applicable repairs, including replacement of materials, at no cost to the Owner for a period of one year from the date of final acceptance.
  - 1. If, through no fault on the part of the Owner, the Supplier is unable to meet the required delivery dates established at the time of the signing of an agreement, Supplier agrees to furnish substitute equipment of the same quantity and of comparable type and quality to the job site.
- B. This equipment will be extended to the Owner at no additional cost until the delivery of the presentation area lighting fixture list has been completed.

**PART 2 - PRODUCTS**

2.1 STAGE LIGHTING FIXTURE SUPPLIERS

- A. Stage lighting fixture supplies for work of the section include the following:
  - 1. Norcostco  
Minneapolis, MN  
1 (800) 220-6920  
<https://norcotco.com/>
  - 2. Barbizon Lighting  
Dallas, TX  
(972) 416-9930  
<https://www.barbizon.com/>
  - 3. 4-Wall Entertainment  
Houston, TX  
(281) 209-1944  
<https://www.4wall.com/>

2.2 STAGE LIGHTING FIXTURES

- A. LED stage lighting fixtures supplied with all standard equipment, including the following:
  - 1. Edison parallel blade U ground connector installed on a minimum 5-foot centers, three wire PowerCon lead.
  - 2. Center pivot type "C" clamp and yoke
  - 3. One safety cable
  - 4. Each SpectraCyc shall also include 10-foot long DMX signal extension cables and DMX terminators
- B. Lamp designations listed with each fixture type in the Stage Lighting Fixture & Equipment Schedule to identify the type of lamp used for each fixture.
- C. The manufacturer(s) for each fixture is included in "QT Vendor General Contact Info". No substitutions will be allowed and each item furnished shall conform in all respects to the product description found on the data sheets.

2.3 JUMPER CABLES

- A. All 20A jumpers shall be made of black type "SO" (extra hard usage), three conductor, #12 cable with specified colored tape at each end and installed 20A Edison parallel blade U ground connector(s)
  - 1. All jumpers shall be made with strict observance of polarity.
- B. Two-fers shall be of black type "SJ" (junior hard service), three (3) conductor, #12 cable with installed Edison parallel blade U ground connector(s)
  - 1. All two-fers shall be made with strict observance of polarity.
- C. All PowerCON to PowerCON fixture to fixture Power Thru jumper cables shall be made of black type "SJ" (junior hard service), three conductor, #12 cable with installed standard Neutrik PowerCON connectors.
- D. All TrueOne to TrueOne fixture to fixture Power Thru jumper cables shall be made of black type "SJ" (junior hard service), three conductor, #12 cable with installed standard Neutrik TrueOne connectors.



**PART 3 - EXECUTION**

**3.1 INSTRUMENT PREPARATION**

- A. After delivery and prior to installation, prepare the stage lighting fixtures with the following:
  - 1. Unpack from carton
  - 2. Install C-clamp and all associated hardware, including safety cable
  - 3. Install lamp
  - 4. Initial bench-focus

**3.2 INSTALLATION**

- A. Install stage lighting instruments in locations as shown on the Light Plot or as directed by Owner's Representative.
- B. Connect stage lighting instruments to nearest stage lighting outlet using jumper cables, two-fers, etc. as required or as directed by Owner's Representative.
- C. Focus all stage lighting instruments shown on the Light Plot as directed by Owner's Representative.

**3.3 INSTALLATION SUPERINTENDENT**

- A. Installation of the stage lighting fixtures shall be supervised by the Stage Lighting Fixture Supplier's own experienced superintendent, having extensive experience in installing instruments of this kind.
- B. Superintendent represents the Supplier, and all responsibilities are as binding as if given to the Supplier.
- C. The same individual shall remain in charge of the work throughout the installation of the stage lighting fixtures until work is completed excepting only the intervention of circumstances completely beyond the control of the Supplier.

**3.4 INSTALLATION LABOR BY SUPPLIER**

- A. The Supplier shall carry out the installation of the stage lighting fixtures using experienced professional stage rigging technicians
  - 1. Do not employ any person to do work of a particular craft unless that person is qualified in that craft

**3.5 PROTECTION AND CLEANING**

- A. The Supplier is solely and exclusively responsible for the following:
  - 1. Satisfactory installation, plugging and focusing of these stage lighting fixtures
  - 2. Furnishing and storing all equipment and tools during the period of installation.
  - 3. Collecting and removing from the job site all packing materials, trash, scrap materials, etc. from these stage lighting fixtures
  - 4. Protection of equipment and/or finished materials provided by other contractors

**3.6 FIELD QUALITY CONTROL AND WORK**

- A. Prior to the completion of the installation, the Supplier shall notify the Architect and Owner's Representative to arrange on a date for inspection of the installation.
  - 1. At the time of the inspection, the Supplier shall furnish sufficient personnel to operate equipment and to perform adjustments and tests as may be required by the Owner's representatives.
  - 2. Repair or replace any equipment that fails to meet Specifications with new equipment
    - a. Re-inspect under the same conditions listed previously
  - 3. Final approval will be withheld until all fixtures and equipment have been thoroughly tested and found to be in first class operating condition in every circumstance.

END OF SECTION 11 61 19

## SECTION 11 61 23

### THEATRICAL AND ACOUSTIC DRAPERY AND TRACK

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This section includes all labor, materials, equipment, and services necessary to manufacture and deliver to job site and install the stage drapery and track as shown on the drawings and/or listed in schedules.
- B. Related work in other Sections:
  - 1. 116133 – Motorized Stage Rigging
  - 2. 116136 – Counterweight Stage Rigging and Pin Rails
  - 3. 116137 – Fixed Lighting Positions

##### 1.2 SUBMITTALS

- A. Submit shop drawings for review before fabrication can begin. Such review does not relieve the Manufacturer of the responsibility of providing equipment in accordance with this Specification.
  - 1. Show each type of curtain track plus the method and equipment to be used in hanging the curtain track.
    - a. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.
  - 2. Provide field verified dimensions of all drapery and track.
  - 3. Show exact locations for work required of other trades, including all welded, concrete, or masonry connections.
    - a. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
    - b. Furnish drawings and coordinate all work required of other trades that affects the work of this section.
- B. Product Data: for Drapery Track and Textiles
- C. Samples:
  - 1. Manufacturer's color line sample card
  - 2. 1/2-yard x full width minimum size sample of each color of each fabric type, including custom colors matched to architects control sample.
  - 3. Label each sample with Manufacturer and Manufacturer's identification numbers.
  - 4. Guarantee dye lots for all materials.
- D. No extras will be allowed due to the Manufacturer's misunderstanding as to the amount of work involved or lack of knowledge of any field conditions based on neglect or failure to make field measurements or thorough investigation of the job site.
- E. Provide Operations and Maintenance manuals containing record shop drawings, operation instructions and recommended maintenance procedures for all equipment, in quantity outlined in Division 01.
- F. Product certificates: for each drapery fabric treated with flame retardant, signed by fabric supplier and indicating treating durability and cleaning procedures required to maintain treatment effectiveness.

##### 1.3 MANUFACTURERS RESPONSIBILITIES

- A. Study the contract drawings and specifications with regard to the work as shown and required under this section so as to insure its completeness.
- B. Manufacture and install equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.
- C. Verify all dimensions affecting the work.

##### 1.4 CONTRACTORS RESPONSIBILITIES

- A. Verify that the job conditions are ready to receive work in this section. Contractor must bring forth any existing conditions that may adversely affect execution of work, so that resolution may be reached before commencement of installation

1.5 DELIVERY

- A. Bid price shall include full freight and insurance charges for the delivery of all drapery items to the job site.
- B. If, through no fault of the Owner, the timely completion of the work of this section is imperiled, the Manufacturer shall prevent or minimize any delay by shipping the required products by airfreight, at no additional cost to the Owner.
  - 1. This requirement covers initial delivery of fabrics to the Drapery Manufacturer, and delivery of finished drapery to the job site.
- C. Carefully wrap and seal each drapery item tight for shipment in rigid and waterproof wrapping material to insure against impact and water damage during shipment.

1.6 WARRANTY

- A. Manufacturer agrees to make all repairs, including replacement of materials, made necessary due to defects in workmanship and materials without additional cost to the Owner for a period of two years from the date of acceptance.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Manufacturers for work in this section:
  - 1. BellaTEX Stage Curtains
  - 2. Jackson, TN
  - 3. (731) 300-3141
  - 4. <http://bellatex.com/>
  - 5. I. Weiss Inc.
  - 6. Fairview, NJ
  - 7. (201) 402-6500
  - 8. <https://www.iweiss.com/>
  - 9. Rose Brand
  - 10. Secaucus, NJ
  - 11. (201) 809-1730
  - 12. <https://www.rosebrand.com/>
  - 13. Stage Decorations and Supplies
  - 14. Greensboro, NC
  - 15. (888) 220-3174
  - 16. <http://www.stagedec.com/>

2.2 FABRICS

- A. All fabrics shall be inherently flame retardant and shall meet all requirements set forth in NFPA #701, Large and Small Scale.
  - 1. Furnish affidavit of flame proofing in the form acceptable to local authorities.
- B. The following fabrics are approved for drapery use:
  - 1. Surround Drapery: Encore, 22 oz. Trevira CS, 54-inch-wide, IFR, supplied by Milliken & Company, Spartansburg, SC
  - 2. Cyclorama: Seamless IFR Trevira CS "muslin"
  - 3. Green Screen: Chroma Key green; 100% polyester 38.71 oz., 128-inch-wide, IFR, supplied by Milliken & Company, Spartansburg, SC

2.3 TOP FINISH TYPES

- A. Webbing:
  - 1. 3-inch-wide polypropylene webbing
  - 2. Double layer hemmed fabric
  - 3. No visible selvage or fabric edge
  - 4. Mark centerline of drape on webbing in indelible ink
- B. Grommets with Tie Line:
  - 1. 12-inch centers
    - a. First grommet at center or split center
    - b. Last grommet within 2 inches of offstage edges

2. Grommets: #2 or #3 brass type
  3. Tie lines: #4 braided masonry line
    - a. 36 inches long
    - b. Color: Black, unless otherwise noted
    - c. Choke tie lines into grommets
    - d. Provide single white tie line at center grommet or both grommets that split center
- C. Snap Hooks:
1. Installed to top webbing with 2-inch nylon straps
  2. Hooks flush to top of drape for installation to track carriers
- 2.4 BOTTOM FINISH TYPES
- A. Flat:
1. 4-inch hemmed return
  2. Binding tape pressed between layers prior to stitching
- B. Chain Pocket:
1. 5-inch wrapping an internal nylon pocket
    - a. Lined with #8 jack chain
    - b. Whip-stitch chain to pocket at 12-inch intervals to prevent shifting
  2. Float chain in pocket 1 inch above bottom of drape.
- C. Lead Weight:
1. 4-inch hemmed tape wrap
- D. Pipe Pocket and Flap:
1. 4-inch, #8 canvas or nylon pocket for 1/2-inch pipe, sewn onto back of the bottom hem
  2. Provide reinforced openings along pocket at 10-foot nominal centers for partial piping and insertion
- 2.5 SIDE FINISH TYPES
- A. Flat:
1. 4-inch hemmed return
  2. Binding tape pressed between layers prior to stitching
  3. Hide selvage or fabric edge inside double fold side hem
- B. Flat with Grommets and Ties:
1. 4-inch hemmed return
  2. Binding tape pressed between layers prior to stitching
  3. Hide selvage or fabric edge inside double fold side hem
  4. Grommets and Tie Lines:
    - a. 12-inch centers
    - b. Grommets:
      - 1) #2 or #3 brass type
    - c. Tie lines:
      - 1) #4 braided masonry line
      - 2) 36 inches long
      - 3) Color: black unless otherwise noted
      - 4) Choke tie lines into grommets
- 2.6 DRAPERY
- A. General:
1. Stitch with nylon thread without flaws
    - a. Each width of cloth continuous for the full height of the drapery with no horizontal seams or piercing
- 2.7 DRAPERY
- A. General:
1. Stitch with nylon thread without flaws
    - a. Each width of cloth continuous for the full height of the drapery with no horizontal seams or piercing
- B. Valance Drapery Panel:
1. Color: TBD
  2. Vertical Seams

3. Fullness: As scheduled – box pleat
  4. Top: Webbing and grommets with tie line
  5. Bottom: size as scheduled, Lead Weight
  6. Sides: size as scheduled, Flat
  7. Attach to:
- C. Velour Bi-Part Curtain Panels (Main Drape and Travelers):
1. Main Drape Color: TBD
  2. Traveler Color: Black
  3. Vertical seams
  4. Fullness: As scheduled – box pleat
  5. Top: Webbing and snap hooks
  6. Bottom: size as scheduled, Lead Weight
  7. Sides: size as scheduled, Flat
- D. Velour Borders:
1. Color: Black
  2. Vertical seams
  3. Fullness: as scheduled – box pleat
  4. Top: Webbing and grommets with tie line
  5. Bottom: size as scheduled, Lead Weight
  6. Sides: Flat
- E. Velour Legs and Tabs:
1. Color: Black
  2. Vertical seams
  3. Fullness: as scheduled – box pleat
  4. Top: Webbing and grommets with tie line
  5. Bottom: size as scheduled, Lead Weight
  6. Sides: Flat
- F. Sharktooth Scrim:
1. Color: Black
  2. Seamless
  3. Top: Webbing and grommets with tie line
  4. Reinforce Top with a piece of 3-inch wide #8 canvas in between the scrim and the webbing
  5. Bottom: Pipe Pocket and Flap
  6. Side: Flat
- G. Cyclorama Panels:
1. Color: White
  2. Seamless
  3. Top: Snap Hooks
  4. Bottom: Pipe Pocket and Flap
  5. Side: Flat
- 2.8 CURTAIN TRACKS
- A. Verify all track lengths in the field before fabrication.
- B. Bi-Parting Traveler Drapery Curtain Tracks:
1. Provide all hardware required for cord-operated ADC 2800 (BL) or H&H 400 series curtain track system in lengths and locations as shown on the drawings.
    - a. Complete with all necessary accessories (CWANA), including hanging clamps, track splices, master carriers, single carriers, center pipe supports, and end stops for all tracks.
    - b. Track and hardware color: Natural Finish
    - c. Furnish adequate carriers to serve number of drapery grommets, plus 10% spare carriers.
    - d. Equip with backpack/rear fold devices for offstage curtain gathering.
    - e. Track:
      - 1) Minimum 14-gauge galvanized steel construction
      - 2) Continuous, full lengths with as few joints as possible.
- C. Walk Along Curtain Tracks:
1. Provide all hardware required for walk along ADC 1400 (BL) or H&H 300 Series curtain track system in lengths and locations as shown on the drawings.
    - a. Complete with all necessary accessories (CWANA), including hanging clamps, track splices, master carriers, single carriers, center pipe supports, and end stops for all tracks.

- b. Track color: Mill Finish
  - c. Hardware color: Natural Finish
  - d. Furnish adequate carriers to serve number of drapery grommets, plus 10% spare carriers.
  - e. Track:
    - 1) Minimum 11-gauge extruded aluminum
      - a) Continuous, full lengths with as few joints as possible.
  - f. Tag line
    - 1) Tie a #8 cotton braided masonry cord at the lead carrier on the end of each drape
    - 2) Line length: from carrier to 4 feet above finished floor
2. Suspend from structure or pipe battens as indicated on drawings
- a. Must permit adjustment of height as well as simple re-positioning of the system when required
  - b. Support spacing per manufacturer, min.
- D. Architectural Lighting Tracks:
1. Provide all hardware required for walk along ADC 1400 (BL) or H&H 300 Series curtain track system in lengths and locations as shown on the drawings.
- a. Complete with all necessary accessories (CWANA), including hanging clamps, track splices, master carriers, single carriers, center pipe supports, and end stops for all tracks.
  - b. Track color: Black
  - c. Hardware color: Black
  - d. Furnish adequate carriers to serve number of architectural lighting fixtures.
  - e. Track:
    - 1) Minimum 11-gauge extruded aluminum
      - a) Continuous, full lengths with as few joints as possible.
  - f. Tag line
    - 1) Tie a #8 cotton braided masonry cord at the lead carrier on the end of each drape
    - 2) Line length: from carrier to 4 feet above finished floor
2. Suspend from structure or pipe battens as indicated on drawings
- a. Must permit adjustment of height as well as simple re-positioning of the system when required
  - b. Support spacing per manufacturer, min.
- 2.9 ACCESSORIES
- A. Furnish 1/2" NPS schedule 40 steel pipe or 3/4" IMT conduit, threaded and coupled, for use as curtain panel bottom stretcher.
- 1. Provide enough 10' lengths of bottom pipe for all items listed in the schedules as having a pipe pocket. Pipes shall be 12" longer than finished drapery.
  - 2. Provide one (1) additional 10'-0" lengths, and one (1) 5'-0" lengths.
  - 3. Provide one (1) end cap and (1) pipe coupler for each pipe segment, to protect fabric during insertion of pipe and to permit joining of segments.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION CONTRACTORS

- A. Installers for work in this section:
- 1. Weiss Inc.  
Fairview, NJ  
(201) 402-6500  
<https://www.iweiss.com/>
  - 2. Barbizon  
Carrollton, TX  
(972) 416-9930  
<https://www.barbizon.com/>
  - 3. Chicago Flyhouse  
Chicago, IL  
(773) 533-1590  
<https://www.flyhouse.com/>
  - 4. Clearwing Productions  
Denver, CO

- (303) 232-3540  
<https://www.clearwing.com/>
5. Texas Scenic Co.  
San Antonio, TX  
(210) 684-0091  
Bronx, NY  
(718) 402-2677  
<https://www.texasscenic.com/>
6. Wenger Corporation  
Owatonna, MN  
(800) 268-0148  
<https://www.wengercorp.com/>

- B. Drapery installation Contractor shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
1. 116133 – Motorized Rigging
  2. 116136 – Counterweight Rigging
  3. 116137 – Fixed Lighting Positions
  4. 116139 – Fire Safety Curtain

### 3.2 GENERAL

- A. Examine substrates, area, and conditions for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the work
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Responsibility for the satisfactory completion of the work in this section shall rest solely and exclusively with the General Contractor
- D. Field verify condition of delivered goods, and repair or replace any components not in factory new condition. All materials shall remain covered or protected from debris, dust, paint, and other site hazards throughout the period between delivery to site and Owner training.
- E. Installer shall be responsible for repairing any damage to jobsite surroundings during installation.
- F. All components shall be installed plumb, straight, and true, and shall function as designed. Anchors, connecting members, brackets, and associated fastening means and methods for properly supporting and bracing equipment shall be furnished and installed following best suitable practice for each condition.
- G. Prior to the completion of the installation, the Installer shall notify the Construction Manager or General Contractor to arrange on a date for observation of the system.
1. At the time of the observation, the Installer shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Owner's representatives.
  2. Any equipment that fails to meet with the Specifications shall be repaired or replaced with new equipment, and the inspection shall be re-scheduled under the same conditions listed previously.
  3. Final review will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

### 3.3 INSTALLATION SUPERVISION

- A. Installation of the Drapery and track system shall be supervised by the Contractor's own experienced superintendent having extensive experience in installing work of this kind.
- B. The same individual shall remain in charge of the work throughout the installation of the rigging system until work is completed excepting only the intervention of circumstances completely beyond the control of the Contractor.
- C. The superintendent shall represent the Contractor and all directions given to him shall be binding as if given to the Contractor.
- D. The Contractor may require the Owner to confirm such directions in writing.

### 3.4 OWNER TRAINING

- A. Manufacturer's installation Supervisor shall perform Owner training as outlined in Division 01 specifications to include the following:
1. Operation of curtain tracks.
  2. Installation, dismantling, and storage of draperies.

3. Care and maintenance.
  4. Warranty review.
- B. Documentation of Owner training shall be furnished as outlined in Division 01 specifications.

END OF SECTION 11 61 23



## SECTION 11 61 33

### MOTORIZED RIGGING

#### PART 1 - GENERAL

##### 1.1 WORK OF THIS SECTION

- A. This Section includes all labor, materials, equipment, and services necessary to furnish and install the Stage Rigging System as shown on the QT drawings and/or specified herein, including but not limited to the following:
  - 1. Seven motorized, fully rigged, six line, line sets with cable management and associated equipment.
  - 2. Mule blocks, idler sheaves, cable rollers or guides as required assuring proper alignment and operation of the rigging system.
- B. Related work in other sections:
  - 1. 116136 – Counterweight Rigging
  - 2. 116139 – Fire Safety Curtain
  - 3. 116123 – Drapery and Track
  - 4. 116113 – Networked Theatrical Lighting Control
  - 5. 116116 – Theatrical Lighting Wiring Devices
  - 6. 116163 – Acoustic Equipment

##### 1.2 SUBSTITUTIONS

- A. Substitutions are allowed when the substitution improves the quality, decrease installation time, or reduce cost.
  - 1. Submit a proposal that clearly outlines construction features of the product so that true and accurate comparisons may be made.
    - a. Samples of the proposed substitution item/s may be requested by the Architect and/or Owner for evaluation
- B. No product bid which deviates from the details of the Construction Documents will be considered unless such deviation has been approved in advance by the Architect

##### 1.3 PROJECT CONDITIONS

- A. Provide all new equipment of the latest design
- B. No extras will be allowed due to the Contractor's misunderstanding of the work involved or its lack of knowledge of any field conditions due to failure to make accurate field measurements or a thorough investigation of the job site.

##### 1.4 SUBMITTALS

- A. Stage Rigging Contractor shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.
- B. Submit shop drawings for review by the Architect before fabrication can begin. Such review does not relieve the Contractor of the responsibility of providing equipment in accordance with this Specification.
- C. Shop Drawings:
  - 1. Show dimensions, sizes, gauges, thicknesses, finishes, joining, attachments and relationship of work to adjoining construction.
  - 2. Clearly show power, wire, and conduit requirements for all work to be provided by the Contractor.
  - 3. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
  - 4. Where other materials must be set to exact locations to receive rigging, furnish assistance and directions necessary to permit other trades to locate their work.
  - 5. Where welded connections, concrete or masonry inserts are required to receive work, show exact locations required and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts.
  - 6. Show locations of all lubrication points.
  - 7. Include engineering and load calculations as well as stamp and seal of a registered professional engineer.

8. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.
  9. Include a copy of the installation superintendent's ETCP Certified Rigger - Theatre certification. A copy of the installation superintendent's ETCP certification shall be available on the job site for the length of the installation.
- D. Any deviation from this Specification shall be clouded and noted in letters a minimum 1/4-inch high.
1. In order for a deviation to be considered, it must upgrade the quality of the equipment or respond to a field condition.
- E. Provide Operation and Maintenance manuals upon completion of installation
1. One O&M manual shall be a printed hard copy.
  2. O&M manual shall also be provided in electronic format on two flash drives
  3. Manuals to include, but not limited to:
    - a. Copies of all record shop drawings
    - b. Parts lists
    - c. Operational instruction,
    - d. Service/maintenance recommendations
    - e. Component working load limits
- F. Rigging System Log Book:
1. At Owner training, furnish a system log book, configured to permit Owner tracking of inspections, system issues and maintenance history. Provide overview of observations and actions that should be documented for appropriate record keeping and compliance with industry standards for safety. Log book shall include:
    - a. Schedule and ID of all installed rigging sets (manual and motorized).
    - b. Identification of design parameters for each set, including high and low trim limits, set live loading capacity, hoist configuration settings, etc.
    - c. Log sheet for periodic system-wide inspections, including commissioning date of system as first entry.
    - d. Journal fields for each set to document date, status, observations, actions taken, and resolution.
- 1.5 CONTRACTOR RESPONSIBILITIES
- A. Prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents
- B. Verify, by field measurement on the job site, all dimensions affecting the work.
1. Bring field dimensions which vary from those on the approved shop drawings to the attention of the Architect.
    - a. If required, obtain a directive from the Architect and Owner regarding corrective measures before the start of fabrication of items affected by the variance.
- C. Install equipment complete in all respects and provide any additional equipment required to fulfill the intent of the drawings and specifications regardless of whether or not such items are herein specified or indicated.
- D. If requested by the Owner or Architect, provide satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of hardware to be used in this contract.
1. The samples shall be retained by the Owner until such time that this contract has been completed and accepted
- 1.6 WARRANTY
- A. The Contractor shall assure that the rigging is properly installed, free of defects in materials and workmanship and shall provide a warranty on all equipment and workmanship provided under this contract for a period of two (2) years from the date of the final acceptance.
- B. During the warranty period, repair or replacement of defective materials and faulty workmanship shall be provided, at no cost to the Owner, within ten days of written notification of defects(s).
- C. Post Installation Safety Inspection:
1. One year after the date of final acceptance by the Owner, the Stage Rigging Contractor Supervisor shall return to the job site to conduct a thorough inspection of the rigging installation.
    - a. Check all bolts and tighten as required, inspect all cable connections and cables
    - b. Give all items a thorough safety inspection in compliance with ANSI E1.47, Entertainment Technology – Recommended Guidelines for Entertainment Rigging System Inspections.

- c. Repair or replace all damaged items
- d. If the original supervisor is unavailable either because the supervisor no longer works for the contractor or due to issues fully beyond the control of the contractor, then an alternate rigger superintendent shall perform the inspection, under the following conditions:
  - 1) The alternate superintendent shall be ETCP-RT certified.
  - 2) The alternate superintendent shall have experience supervising installation on projects of similar scope and scale.
2. The Contractor is responsible for all materials, superintendent labor, transportation and living expenses for this work at no additional cost to the Owner.
  - a. Conduct inspection and repair work during normal working hours at a time mutually agreed upon by the Owner and the Contractor.
3. Provide the Owner and Architect with a written report stating the findings of the inspection within two weeks of completion of the inspection

## **PART 2 - PRODUCTS**

### **2.1 STAGE RIGGING MANUFACTURERS**

- A. Pre-approved Stage Rigging Manufacturers for work of this section shall include:
  1. Electronic Theatre Controls  
Austin, TX  
(512) 836-2242  
<https://www.etconnect.com/>
  2. J.R. Clancy Inc.  
Syracuse, NY  
(315)451-3440  
<https://www.jrclancy.com/>
  3. Chicago Flyhouse  
Chicago, IL  
(773) 533-1590  
<https://www.flyhouse.com/>

### **2.2 STAGE RIGGING CONTRACTORS**

- A. The Contractor shall have been continuously engaged in the production of theatrical stage rigging equipment for at least fifteen years.
- B. The Contractor shall have installed a total of not less than five installations of equal or greater scope to system specified herein, which have been in service for a minimum of one year and a maximum of ten years.
  1. Each of the listed stage rigging installations shall be in service in fully professional commercial theatres being operated by professional technicians.
- C. Stage Rigging Contractors for work of this section shall include:
  1. Chicago Flyhouse  
Chicago, IL  
(773) 533-1590  
<https://www.flyhouse.com/>
  2. Weiss Inc.  
Fairview, NJ  
(201) 402-6500  
<https://www.iweiss.com/>
  3. J.R. Clancy Inc.  
Syracuse, NY  
(315)451-3440  
<https://www.jrclancy.com/>
  4. Stage Rigging Services  
Greensboro, NC  
(336) 370-1900  
<http://www.srsrigging.us/>

5. Texas Scenic Co.  
San Antonio, TX  
(210) 684-0091  
<https://www.texasscenic.com/>

- D. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
1. 116136 – Counterweight Rigging & Pin Rails
  2. 116139 – Fire Safety Curtain
  3. 116163 – Acoustic Equipment

## 2.3 MATERIALS

- A. Ferrous materials and accessories shall conform to the following ASTM and ANSI standard specifications:
1. Standard structural steel shapes and plates:
    - a. ASTM A-36.
  2. Miscellaneous steel items:
    - a. ASTM A-283, grade optional.
  3. Steel pipe:
    - a. ASTM A-53
  4. Gray iron castings:
    - a. ASTM A-48, Class 30 unless otherwise specified.
  5. Malleable iron castings:
    - a. ASTM A-47
  6. Bolts and nuts:
    - a. B18.2.1&2
  7. Welding electrodes shall be as permitted by AWS Code D1.0.
- B. Wire Rope and Fittings
1. Wire rope shall be 7x19 construction, utility cable, sized as required, that meets Federal Specification RR-W-410E.
    - a. Damaged or deformed cables shall not be used.
  2. Use Nicopress copper sleeves or forged steel clips and conform to wire rope manufacturer's recommendations as to size, number and method of installation.
- C. Aluminum Materials and Accessories
1. Thicknesses, gauges and tempers of aluminum products to meet structural standards.
  2. Aluminum Castings: 214 or 356 alloy as per strength requirements.
  3. Fasteners: Include bolts, nuts, washers, screws, nails, rivets and other fastenings necessary for proper erection and/or assembly of aluminum work.
  4. Fabrication shall be by AWS certified welders.
- D. Finishes for Items Without Factory Finish
1. Welds, burrs and rough surfaces on all interior ferrous metals shall be ground smooth and the completed assembly cleaned, and all metal surfaces shall be given a minimum one coat of finish paint.
  2. No painted finish shall be required on aluminum finishes.
  3. Match all exposed fastenings to color and finish of adjacent material.

## 2.4 SAFETY STANDARDS

- A. In order to establish minimum standards of safety, the following factors shall be used:
1. Cables and fittings: 8:1 Safety Factor
  2. Terminating hardware: 5:1, or not exceeding WLL, whichever is more restrictive.
  3. Trim chain assembly: 5:1, or not exceeding WLL, whichever is more restrictive.
  4. Batten clamps: 5:1, or not exceeding WLL, whichever is more restrictive.
  5. Motors: 1.0 Service factor
  6. Gearboxes: 1.25 Mechanical Strength Service Factor
  7. Cable bending ratio: Sheave diameter is 30 times diameter of cable
  8. Tread pressures: 500# for cast iron, 900# for Nylatron, 1000# for steel
  9. Maximum fleet angle: 1-1/2 degrees
  10. Steel: 1/5 of yield
  11. Bearings: L10 life of 2000 hours at two times required load at full speed
  12. Bolts: Grade 5 or better, plated

2.5 SIGNAGE

- A. Provide and install signs with white background and 3/8 inches high red letters to be mounted on the wall on the stage level, fly gallery level, and loading bridge level at a position that is conspicuous to workers performing rigging work.
1. The signs shall read as shown on the drawings.
  2. "Date of Last Inspection" and "Date of Next Required Inspection" information shall be in erasable marker.

2.6 MOTORIZED RIGGING ITEMS

- A. Loft blocks:
1. Underhung
  2. Sheave:
    - a. 8-inch diameter
    - b. Single cast or nylon
    - c. Grooved to conform to rope and cable manufacturer's recommendations
    - d. Machined, faced and bored for shaft and bearings
  3. Bearing:
    - a. At least 2-inch diameter hub
    - b. Two tapered roller bearings in place operating on a 1/2-inch diameter steel shaft or sealed precision ball bearings on a 5/8-inch diameter steel shaft
  4. Shaft:
    - a. Keyed to one side plate to prevent the shaft from rotating
    - b. Thread the opposite end of the shaft and equip with "Flexloc" self-locking nut
  5. Side Plates:
    - a. Minimum of 11-gauge steel
  6. Install loft blocks at spacing as shown on drawings
- B. Mule blocks:
1. Meets the same specifications as the head blocks, except that sheave shall be 10 inches in diameter, provided with suitable universal joint swivel bases and mounting stands or bracket to meet the job conditions.
- C. Idler blocks:
1. Consists of one or more sheaves contained within an assembly to provide only vertical support of the lift lines
  2. Mount to loft blocks or from building structure
- D. Tension blocks:
1. Sheave:
    - a. Cast iron or nylon
    - b. 10-inch diameter
    - c. Grooved for 3/4-inch rope
    - d. Machined, faced and bored for shaft and bearings.
    - e. Housing: one-piece gray iron casting
  2. Bearing:
    - a. 1/2-inch diameter steel shaft threaded
    - b. Two precision ball bearing or tapered roller bearing assemblies
    - c. Held with a hex head nut
  3. Weight: at least 30 pounds
  4. Rides in tee bar by means of UHMW guide assemblies with 1/4-inch steel back plates.
    - a. Secure each guide assembly to the block housing by two 3/8-inch bolts, nuts and lock washers
- E. Pipe Battens:
1. 1-1/2-inch NPS, schedule 40 steel pipe
  2. Splices:
    - a. Sleeve splice all joints
    - b. 18 inches long, 9 inches extending into each pipe.
    - c. Bolt through the sleeve with two 3/8 inches x 1-inch hex head, grade 5 bolts.
      - 1) Drill holes in pipes and sleeves so that all pipe sections are interchangeable
  3. Color: Black (painted)
    - a. Paint the last 12 inches at each end of the truss and pipe batten white or provide yellow plastic end caps.

- b. Mark centerline with a 1/2-inch painted yellow line around the circumference of the bottom pipe
        - c. Paint 1/2-inch-wide white lines at 1-foot increments marked around the circumference of the batten, starting at center and working out to the ends
      4. At each pick-up point, provide a red tape mark on each side of the trim chain for the full circumference of the top pipe.
      5. Line Set Numbers:
        - a. Mark each batten with its line set number
        - b. Color: white
        - c. 1-inch-high numerals
        - d. Mark on the top and bottom of each batten 18 inches from each end, and 12 inches stage left of the centerline mark
      6. Use trim chains for pickup cable batten connections
    - F. Pipe Batten Extensions:
      1. Ten pipe extensions.
      2. Length: 6 feet
      3. 1-inch NPS schedule 80 steel pipe
      4. Must sleeve within the 1-1/2" I.D. pipe batten.
      5. Terminate extensions in a pipe collar welded in place and ground smooth to act as an end stop
      6. Paint extensions white from end – 4 feet
        - a. Paint the last 2 feet bright red
      7. Install extensions on linesets designated by the Owner's representative
    - G. Pickup Cables:
      1. Use 3/16-inch 7 x 19 utility cable
      2. Breaking Strength: 7,000 lbs.
      3. free of oil
      4. Certification required.
    - H. Trim Chains:
      1. Use either J.R. Clancy Grade 63 AlphaChain or SECOA STC chain
        - a. 3,250 pounds working load
        - b. Must meet OSHA 1910.184(e)(5) – Sling use,
        - c. Length: 36 inches
        - d. Use at the batten end of the pickup cables.
      2. One end of the trim chain shall connect to pickup cable with thimbles and Nico-press sleeves.
      3. Fit the other end with a 1/4-inch screw-pin shackle
    - I. Alternative batten clamp Trim Chains:
      1. Assemble trim chain with 1/4-inch screw-pin shackle, steel batten clamp and either J.R. Clancy Grade 63 AlphaChain or SECOA STC chain,
        - 3,250 pounds working load
        - Must meet OSHA 1910.184(e)(5) – Sling use.
    - J. Wall Battens:
      1. Use the same angle iron as the upper and lower stop bumpers
      2. Mount on 5-foot centers
      3. Weld wall battens in place to tilt wall imbeds provided by the General Contractor
      4. Fasten tee bars and hold parallel using "U" shaped clips at each wall batten
  - 2.7 FIXED-SPEED HIGH-CAPACITY HOISTS WITH CABLE MANAGEMENT
    - A. Provide four motorized stage lighting hoists as shown on the drawings.
      1. Basis of Design:
        - a. ETC Prodigy EXO 2000
        - b. Contractor may propose alternative hoist motor/drum types and layouts to review by Architect
        - c. J.R. Clancy PowerLift with cable management system is an acceptable alternate
        - d. If Contractor substitutes another manufacturer for the basis of design, then Contractor assumes responsibility for cost of any and all additional steel, wiring, and other hardware required as a result of this substitution.
          - 1) Line shaft hoists will not be approved.
    - B. Provide three motorized acoustic ceiling hoists as shown on the drawings.
      - a. ETC Prodigy P75

- b. Contractor may propose alternative hoist motor/drum types and layouts to review by Architect
  - c. J.R. Clancy PowerLift with cable management system is an acceptable alternate
  - d. If Contractor substitutes another manufacturer for the basis of design, then Contractor assumes responsibility for cost of any and all additional steel, wiring, and other hardware required as a result of this substitution.
    - 1) Line shaft hoists will not be approved.
- C. Manufacturer shall be responsible for steel, hardware, etc. required to provide means of attachment of the motorized stage lighting batten sets to building structure.
- D. Each motorized set includes:
- 1. Lifting Speed: 20-30 feet per minute
  - 2. Capacity: Per schedule
  - 3. Travel as shown on drawings
  - 4. Drum
  - 5. Motor
  - 6. Reducer
  - 7. Limit switches
  - 8. Overload sensors
  - 9. Slack line detection sensors
  - 10. Encoder
  - 11. Loft Blocks
  - 12. 3/16-inch 7x19 utility lift cables
  - 13. Single-pipe batten in lengths shown on drawings
- E. Motorized Drum Hoist Components
- 1. Drum Construction:
    - a. Winding
    - b. Grooved to accept a single layer of 3/16-inch cable
    - c. Minimum pitch diameter: 28 times the cable diameter
    - d. Unitized welded construction
    - e. Cable Termination:
      - 1) Drill holes at the root of the cable groove through the tubing wall
      - 2) Angle hole 45 degrees off of the radial line to avoid a sharp bend in the cable
    - f. Mounting:
      - 1) Direct mount and key to the output shaft of the reducer
      - 2) Support outboard end by self-aligning flange bearing
  - 2. Motor:
    - a. 480 volt
      - 1) Coordinate with electrical contractor
      - 2) Verify in shop drawings
    - b. AGMA service factor: minimum 1.0 for continuous operation
    - c. Gearing service factor: minimum 1.0
    - d. Mechanical strength factor: 1.3.
  - 3. Reducer:
    - a. Direct coupled
    - b. Oil bath
    - c. Combination helical/worm reducer with an integral motor and brake.
    - d. Cast iron gear case for protection against shock damage and protect shafts with double lip oil seals to prevent leaks.
    - e. Double reduction gear train with the helical gearing before the worm gears for higher torque transmission
  - 4. Primary Brake:
    - a. Direct acting AC or DC electro-magnetic
    - b. Contains a manual release
    - c. Minimum retarding torque equal to 200% of motor full load torque.
    - d. Release the brake by energizing the coil simultaneously with the motor winding to provide fail safe braking in the event of power failure
  - 5. Secondary Brake:
    - a. Overspeed brake
    - b. Failsafe meant to stop and hold the load in case of drive train failure

- c. Can be power released after being applied during or after regular stopping as normal operational sequence.
      - d. If brake is applied, default to an intentional release
      - e. Stage Rigging Contractor may propose alternative methods of secondary braking.
    - 6. Limit Switches:
      - a. Provide four switches
        - 1) Two over-travel switches
        - 2) Two position or end-of-travel switches
      - b. Mechanical assembly
      - c. Independently adjustable switch/cam sets
      - d. Mount to the hoist base in a manner that allows for easy adjustment of the switch settings.
      - e. Fully guarded input shaft and drive chain
      - f. Pin sprockets to the shafts to prevent erroneous feedback and size to allow maximum usable rotation of the limit switch cam.
    - 7. Encoder:
      - a. Solid state optical encoder for position feedback
  - F. Provide mounting steel as required
  - G. Single Pipe Battens:
    - 1. 1-1/2-inch NPS schedule 40 pipe batten with sleeve splice
    - 2. Color: Black (painted)
    - 3. Attach yellow plastic end caps to each end of the battens
    - 4. Mark battens per detail in Contract Drawings
  - H. Provide cable management devices with connector strip power and Ethernet conductors.
    - 1. Cable management devices shall be located as shown on drawings.
    - 2. Cable management devices shall provide permanent electrical connection for the stage lighting dimming circuits.
    - 3. Provide Cable management devices in stage lighting circuit quantities as shown on the drawings.
    - 4. Cable management devices shall include Cat6 cable management for stage lighting dimming system low voltage Ethernet control network.
- 2.8 STAGE RIGGING CONTROL PANEL:
  - A. Basis of design:
    - 1. ETC Quick Touch+ MK2 12 Channel
    - 2. Contractor may propose alternative control panels subject to review by Architect.
    - 3. If Contractor substitutes another manufacturer for the basis of design, then Contractor assumes responsibility for cost of any and all additional steel, wiring, and other hardware required as a result of this substitution.
  - B. General:
    - 1. Wall-mount style controller
  - C. Control Interface:
    - 1. Provide operator control panel that features "Go Up", "Go Down", and "Go Target" pushbuttons
    - 2. Shall have integral emergency stop button
  - D. Recorded Cues and Presets:
    - 1. An operator recording cues and presets may specify:
      - a. Target position
        - 1) A specific target position, a relative move (e.g. go out 10 feet), or a match to a present or previous position.
      - b. Acceleration
        - 1) A set specific rate or a default value
      - c. Speed
        - 1) A velocity, a percentage of full speed, or a travel time. Default values also supported.
      - d. Deceleration
        - 1) A set specific rate or a default value
      - e. Number of hoists controlled
        - 1) each with its own speed and target
      - f. Synchronized Groups
      - g. Cue and preset names and labeling
  - E. Safety Requirements:
    - 1. Movement is only initiated by hold to run (deadman) hardware pushbuttons or joysticks



2. A console-controlled limit function
  - a. To allow the operator to set "soft" upper, lower and preset limits for each encoder-equipped hoist.
3. Where the load monitoring option is specified, the control system shall be capable of "learning" the load characteristics and monitoring load changes. The load monitoring system shall accommodate change to the suspended weight of electric cables and other predictable variables, without false tripping.
4. Password-protected for "Access" "Edit" and "System" levels of operation at a minimum.
  - a. Additional user levels shall be password-protected and created as directed by Owner.
5. Height and distance data may be entered as feet and inches, decimal feet, or 100% metric as directed by the Owner.
6. A mushroom head "EMERGENCY STOP" button wired to a failsafe circuit that conforms to NPFA 79 requirements shall be provided.
7. An "ON/OFF" key operated switch shall be provided that removes power to the console, motor starters and drives. Any control system that requires motors and drives energized while the system is not in use is not acceptable.

## 2.9 SIGNAGE

- A. Provide and install signs with white background and 3/8-inch-high red letters to be mounted on the wall adjacent to the tee bar battery on the stage level, fly gallery level, and loading bridge level.
  1. The signs shall read as shown on the drawings.
  2. "Date of Last Inspection" and "Date of Next Required Inspection" information shall be in erasable marker.
- B. Provide numbered labels to identify each line set at loading bridge level, either on the face of the kickplate, on the head block beam or suspended below the head block beam.

## 2.10 RIGGING OF ELECTRICAL MULTICABLES

- A. Rig stage lighting circuit multicable extensions from theatrical lighting system connector strips mounted on stage pipe battens.
- B. Refer both rigging drawings and theatrical lighting drawings for specific details regarding cable lengths and locations

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Examine all conditions under which all presentation area rigging items shall be installed and notify the General Contractor in writing of any condition detrimental to the proper and timely completion of the work.
- B. Contractor is solely and exclusively responsible for the satisfactory completion of this rigging system
  1. Supply all tools required for the successful installation of the equipment herein.
  2. Storage of all equipment and tools during the period of installation and for collecting and removing from the job site all packing materials, trash, scrap materials, etc.
- C. The Contractor shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.
- D. Prior to the completion of the installation, the Contractor shall notify the General Contractor and Architect to schedule an inspection of the system.
  1. At the time of the inspection, the Contractor shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Architect and/or the Owner's representatives.
  2. Repair or replace equipment that does not meet specifications with new equipment
    - a. Reschedule inspection under the same conditions listed previously
  3. Remove all temporary to permit full operation and access to all equipment.
  4. Final review will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

### 3.2 INSTALLATION SUPERVISION

- A. Installation of the rigging systems shall be supervised by the Contractor's own experienced superintendent having extensive experience in installing work of this kind.
  - 1. Superintendent shall be an Entertainment Technician Certification Program (ETCP) Certified Rigger - Theatre.
    - a. Rigging System Contractor shall provide the Architect with a copy of the superintendent's ETCP certification and shall make a copy of this certification available on the job site for the length of the installation.
  - 2. An ETCP Certified Rigger - Theatre shall be present at all times during the rigging system installation.
- B. The same individual shall remain in charge of the work throughout the installation of the rigging system until work is completed excepting only the intervention of circumstances completely beyond the control of the Contractor.
- C. The superintendent shall represent the Contractor and all directions given to him shall be binding as if given to the Contractor.
  - 1. The Contractor may require the Owner to confirm such directions in writing.

### 3.3 FIELD QUALITY CONTROL

- A. Install rigging system in accordance with OSHA Safety and Health Standards and all local codes. All welding shall be in full compliance with the most recent edition of the Structural Welding Code (ANSI / AWS D1.1).
- B. Install all equipment in locations shown on Construction Drawings
  - 1. Install plumb, straight and true and function as designed.
- C. Install all components to prevent abrasion of moving items against any part of the building structure or other equipment.
  - 1. Align sheaves as to provide fleet angles of the cables not exceeding two (2) degrees.
  - 2. Provide mule blocks, cable rollers and guides as required to provide proper alignment and movement around obstructions.
- D. Form cable termination eyes over thimbles of correct size
- E. The Contractor shall perform all drilling and fitting required in the setting of materials and all cutting and fitting required in the fitting of materials to the adjoining work of other Contractors.

### 3.4 OWNER TRAINING

- A. Contractor's installation superintendent shall perform owner training
- B. Schedule instruction with the Owner's designated representatives.
- C. Provide all O&M materials, as designated in this Specification, at the time of training
- D. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
  - 1. Instruction shall not necessarily follow immediately after the system check-out and activation
- E. Provide up to four hours of owner training to include the following:
  - 1. Up to two hours of instruction shall cover the safe and proper operation of the equipment, including limit switch placement and adjustment, use of the control panel, etc., to the Owner's designated representative.
  - 2. An additional two hours of training shall be dedicated to walking up to six users through an ANSI inspection of one lineset of each type.
    - a. ANSI inspection training shall cover what to look and listen for, how to identify common problems in each rigging system, and when a problem needs to be addressed immediately by a professional rigger.
- F. Instruction, at Owner's digression, may occur in multiple time blocks.
  - 1. If training is non-continuous, provide one form for each training segment.
- G. Provide written documentation of Owner training to the Owner upon completion.
  - 1. Form to include:
    - a. The date, time, and location of training.
    - b. Name, title, company and signature of trainer.
    - c. Name, title, and signature of all participants.
    - d. Topics covered at training.

H. Training may be video and audio recorded by the owner at the owner's expense.

END OF SECTION 11 61 33

## SECTION 11 61 36

### COUNTERWEIGHT RIGGING & PIN RAILS

#### PART 1 - GENERAL

##### 1.1 WORK OF THIS SECTION

- A. This Section includes all labor, materials, equipment, and services necessary to furnish and install the Stage Rigging System as shown on the QT drawings and/or specified herein, including but not limited to the following:
  - 1. 22 fully rigged, six-line, single purchase counterweight line sets and associated equipment.
  - 2. Mule blocks, idler sheaves, cable rollers or guides as required assuring proper alignment and operation of the rigging system.
  - 3. Index strip lights and scenery outrigger pipes
  - 4. Fly Gallery pin rails
  - 5. Loading bridge post and chain guard railings
  - 6. Miscellaneous equipment listed herein, for installation by others
- B. Related work in other sections:
  - 1. 116133 – Motorized Rigging
  - 2. 116123 – Theatrical and Acoustic Drapery and Track
  - 3. 116113 – Networked Lighting Control
  - 4. 116116 – Wiring Devices
  - 5. 116119 – Stage Lighting Fixtures

##### 1.2 SUBSTITUTIONS

- A. Substitutions are allowed when the substitution improves the quality, decrease installation time, or reduce cost.
  - 1. Submit a proposal that clearly outlines construction features of the product so that true and accurate comparisons may be made.
    - a. Samples of the proposed substitution item/s may be requested by the Architect and/or Owner for evaluation
- B. No product bid which deviates from the details of the Construction Documents will be considered unless such deviation has been approved in advance by the Architect.

##### 1.3 PROJECT CONDITIONS

- A. Provide all new equipment of the latest design
- B. No extras will be allowed due to the Contractor's misunderstanding of the work involved or its lack of knowledge of any field conditions due to failure to make accurate field measurements or a thorough investigation of the job site

##### 1.4 SUBMITTALS

- A. Stage Rigging Contractor shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents
- B. Submit shop drawings for review by the Architect before fabrication can begin. Such review does not relieve the Contractor of the responsibility of providing equipment in accordance with this Specification.
- C. Shop Drawings:
  - 1. Show dimensions, sizes, gauges, thicknesses, finishes, joining, attachments and relationship of work to adjoining construction.
  - 2. Clearly show power, wire, and conduit requirements for all work to be provided by the Contractor.
  - 3. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
  - 4. Where other materials must be set to exact locations to receive rigging, furnish assistance and directions necessary to permit other trades to locate their work.
  - 5. Where welded connections, concrete or masonry inserts are required to receive work, show exact locations required and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts.

6. Show locations of all lubrication points.
  7. Include engineering and load calculations as well as stamp and seal of a registered professional engineer.
  8. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.
  9. Include a copy of the installation superintendent's ETCP Certified Rigger - Theatre certification. A copy of the installation superintendent's ETCP certification shall be available on the job site for the length of the installation.
- D. Any deviation from this Specification shall be clouded and noted in letters a minimum 1/4-inch high.
1. In order for a deviation to be considered, it must upgrade the quality of the equipment or respond to a field condition.
- E. Provide Operation and Maintenance manuals upon completion of installation
1. One O&M manual shall be a printed hard copy.
  2. O&M manual shall also be provided in electronic format on two flash drives
  3. Manuals to include, but not limited to:
    - a. Copies of all record shop drawings
    - b. Parts lists
    - c. Operational instruction,
    - d. Service/maintenance recommendations
    - e. Component working load limits
- 1.5 CONTRACTOR RESPONSIBILITIES
- A. Prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents
- B. Verify, by field measurement on the job site, all dimensions affecting the work.
1. Bring field dimensions which vary from those on the approved shop drawings to the attention of the Architect.
    - a. If required, obtain a directive from the Architect and Owner regarding corrective measures before the start of fabrication of items affected by the variance.
- C. Install equipment complete in all respects and provide any additional equipment required to fulfill the intent of the drawings and specifications regardless of whether or not such items are herein specified or indicated.
- D. If requested by the Owner or Architect, provide satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of hardware to be used in this contract.
1. The samples shall be retained by the Owner until such time that this contract has been completed and accepted
- 1.6 WARRANTY
- A. The Contractor shall assure that the rigging is properly installed, free of defects in materials and workmanship and shall provide a warranty on all equipment and workmanship provided under this contract for a period of two years from the date of the final acceptance.
- B. During the warranty period, repair or replacement of defective materials and faulty workmanship shall be provided, at no cost to the Owner, within ten days of written notification of defects(s).
- C. Post Installation Safety Inspection:
1. One year after the date of final acceptance by the Owner, the Stage Rigging Contractor Supervisor shall return to the job site to conduct a thorough inspection of the rigging installation.
    - a. All bolts shall be checked and tightened as required, cables and all cable connections inspected and all items given a thorough safety inspection in compliance with ANSI E1.47, Entertainment Technology – Recommended Guidelines for Entertainment Rigging System Inspections.
    - b. All damage not caused by negligence on the part of the Owner shall be repaired and/or replaced.
    - c. If the original supervisor is unavailable either because the supervisor no longer works for the contractor or due to issues fully beyond the control of the contractor, then an alternate rigger superintendent shall perform the inspection, under the following conditions:
      - 1) The alternate superintendent shall be ETCP-RT certified.
      - 2) The alternate superintendent shall have experience supervising installation on projects of similar scope and scale.

2. All materials, superintendent labor, transportation and living expenses for this work shall be furnished by the Stage Rigging Contractor at no additional cost to the Owner.
  - a. The inspection and repair work shall be conducted during normal working hours at a time mutually agreed upon by the Owner and the Stage Rigging Contractor.
3. Within two weeks of the completion of the inspection, the Stage Rigging Contractor shall provide the Owner and Architect with a written report stating the findings of the inspection.

## **PART 2 - PRODUCTS**

### **2.1 STAGE RIGGING MANUFACTURERS**

- A. Pre-approved Stage Rigging Manufacturers for work of this section shall include:
  1. Weiss Inc.  
Fairview, NJ  
(201) 402-6500  
<https://www.iweiss.com/>
  2. J.R. Clancy Inc.  
Syracuse, NY  
(315)451-3440  
<https://www.jrclancy.com/>
  3. Texas Scenic Co.  
San Antonio, TX  
(210) 684-0091  
<https://www.texasscenic.com/>

### **2.2 RIGGING CONTRACTORS**

- A. The Stage Rigging Contractor shall have been continuously engaged in the production of theatrical stage rigging equipment for at least fifteen years.
- B. The Stage Rigging Contractor shall have installed a total of not less than five installations of equal or greater scope to system specified herein, which have been in service for a minimum of one year and a maximum of ten years.
  1. Each of the listed stage rigging installations shall be in service in fully professional commercial theatres being operated by professional technicians.
- C. Pre-approved Stage Rigging Contractors for work of this section shall include:
  1. Chicago Flyhouse  
Chicago, IL  
(773) 533-1590  
<https://www.flyhouse.com/>
  2. Weiss  
Fairview, NJ  
(201) 402-6500  
<https://www.iweiss.com/>
  3. J.R. Clancy Inc.  
Syracuse, NY  
(315)451-3440  
<https://www.jrclancy.com/>
  4. Texas Scenic  
San Antonio, TX  
(210) 684-0091  
<https://www.texasscenic.com/>
- D. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
  1. 116133 – Motorized Rigging
  2. 116136 – Counterweight Rigging
  3. 116139 – Fire Safety Curtain
  4. 116163 – Acoustic Equipment

## 2.3 MATERIALS

- A. Ferrous materials and accessories shall conform to the following ASTM and ANSI standard specifications:
1. Standard structural steel shapes and plates:
    - a. ASTM A-36.
  2. Miscellaneous steel items:
    - a. ASTM A-283, grade optional.
  3. Steel pipe:
    - a. ASTM A-120
  4. Gray iron castings:
    - a. ASTM A-48, Class 30 unless otherwise specified.
  5. Malleable iron castings:
    - a. ASTM A-47
  6. Bolts and nuts:
    - a. B18.2.1&2
  7. Welding electrodes shall be as permitted by AWS Code D1.0.
- B. Wire Rope and Fittings
1. Wire rope shall be 7x19 construction, utility cable, sized as required, that meets Federal Specification RR-W-410E.
    - a. Damaged or deformed cables shall not be used.
  2. Use Nicopress copper sleeves or forged steel clips and conform to wire rope manufacturer's recommendations as to size, number and method of installation.
- C. Aluminum Materials and Accessories
1. Thicknesses, gauges and tempers of aluminum products to meet structural standards.
  2. Aluminum Castings: 214 or 356 alloy as per strength requirements.
  3. Fasteners: Include bolts, nuts, washers, screws, nails, rivets and other fastenings necessary for proper erection and/or assembly of aluminum work.
  4. Fabrication shall be by AWS certified welders.
- D. Finishes for Items Without Factory Finish
1. Welds, burrs and rough surfaces on all interior ferrous metals shall be ground smooth and the completed assembly cleaned and all metal surfaces shall be given a minimum one coat of finish paint.
  2. No painted finish shall be required on aluminum finishes.
  3. Match all exposed fastenings to color and finish of adjacent material.

## 2.4 SAFETY STANDARDS

- A. In order to establish minimum standards of safety, the following factors shall be used:
1. Cables and fittings: 8:1 Safety Factor
  2. Terminating hardware: 5:1, or not exceeding WLL, whichever is more restrictive.
  3. Purchase lines: Min. tensile strength of 4,860# when new.
  4. Trim chain assembly: 5:1, or not exceeding WLL, whichever is more restrictive.
  5. Batten clamps: 5:1, or not exceeding WLL, whichever is more restrictive.
  6. Fiber rope lifting lines: 10:1, min. 5/8" diameter.
  7. Motors: 1.0 Service factor
  8. Gearboxes: 1.25 Mechanical Strength Service Factor
  9. Cable bending ratio: Sheave diameter is 30 times diameter of cable
  10. Tread pressures: 500# for cast iron, 900# for Nylatron, 1000# for steel
  11. Maximum fleet angle: 1-1/2 degrees
  12. Steel: 1/5 of yield
  13. Bearings: L10 life of 2000 hours at two times required load at full speed
  14. Bolts: Grade 5 or better, plated

## 2.5 GENERAL PURPOSE SINGLE-PURCHASE COUNTERWEIGHT RIGGING

- A. The general-purpose stage rigging system shall be single purchase, tee-bar guided line sets. Each set shall include the following:
1. One upright 12-inch head block, with sheave grooved for six cables and one rope.
  2. Six 8-inch underhung/upright loft blocks, each grooved for one cable.
  3. One counterweight arbor with 1800 lbs. load capacity.
  4. One safety rope lock at stage level locking rail
  5. One 3/4-inch Multiline II or SureGrip synthetic rope purchase line.

6. One tension block.
7. Six 1/4-inch 7 x 19 galvanized aircraft cables, fitted with trim chains, screw-pin shackles, safety bolt, wire rope thimbles, and swage fittings.
8. One 60'-0" pipe batten, as shown on drawings, of 1-1/2-inch NPS, schedule 40 steel pipe with internal splices, line set numbers at each end.
9. For each line set, provide 1200 lbs. of steel counterweight per set, 80% at 2 inches thick, and 20% at 1 inch thick
  - a. Distribute 95% of the counterweight along the loading bridge and 5% along the stage fly gallery.

## 2.6 SINGLE PURCHASE COUNTERWEIGHT RIGGING ITEMS

- A. Head blocks:
1. Underhung
  2. Equip at least six pipe spacers, through bolted to the side plates, to prevent cables escaping from the sheave grooves.
  3. Sheave:
    - a. 12-inch diameter
    - b. Grooved to conform to rope and cable manufacturer's recommendations.
    - c. Single cast or nylon sheave shall be
    - d. Machined, faced, lathe turned and grooved for the respective number of 1/4-inch cables and one 3/4-inch rope.
  4. Bearing:
    - a. At least 1-inch diameter hub
    - b. Tapered roller bearings with felt seals press fitted in the head block bore.
  5. Shaft:
    - a. Keyed to one side plate or otherwise restrained to prevent rotation.
    - b. Proper adjustment of the bearings to be accomplished by "Flexloc" self-locking nut on the opposite side of the shaft.
  6. Side plates:
    - a. At least 10-gauge steel
    - b. Weld each side plate to the base angle
  7. Mounting Angle Iron:
    - a. Two support angles for each head block for mounting to building structure
      - 1) Sized to support the specified loads
    - b. Minimum of two bolts per base angle or mounting clips of sufficient size.
  8. Aligned so that each groove, its center and sides, remain in the same vertical axis when the sheave is rotated.
  9. Provide additional support steel to elevate the head block as required.
- B. Loft blocks:
1. Underhung
  2. Sheave:
    - a. 8-inch diameter
    - b. Single cast or nylon
    - c. Grooved to conform to rope and cable manufacturer's recommendations
    - d. Machined, faced and bored for shaft and bearings
  3. Bearing:
    - a. At least 2-inch diameter hub
    - b. Two tapered roller bearings in place operating on a 1/2-inch diameter steel shaft or sealed precision ball bearings on a 5/8-inch diameter steel shaft
  4. Shaft:
    - a. Keyed to one side plate to prevent the shaft from rotating
    - b. Thread the opposite end of the shaft and equip with "Flexloc" self-locking nut
  5. Side Plates:
    - a. Minimum of 11-gauge steel
  6. Install loft blocks at spacing as shown on drawings
- C. Mule blocks:
1. Meets the same specifications as the head blocks, except that sheave shall be 10 inches in diameter, provided with suitable universal joint swivel bases and mounting stands or bracket to meet the job conditions.



- D. Idler blocks:
  - 1. Consists of one or more sheaves contained within an assembly to provide only vertical support of the lift lines
  - 2. Mount to loft blocks or from building structure
- E. Tension blocks:
  - 1. Sheave:
    - a. Cast iron or nylon
    - b. 10-inch diameter
    - c. Grooved for 3/4-inch rope
    - d. Machined, faced and bored for shaft and bearings.
    - e. Housing: one-piece gray iron casting
  - 2. Bearing:
    - a. 1/2-inch diameter steel shaft threaded
    - b. Two precision ball bearing or tapered roller bearing assemblies
    - c. Held with a hex head nut
  - 3. Weight: at least 30 pounds
  - 4. Rides in tee bar by means of UHMW guide assemblies with 1/4-inch steel back plates.
    - a. Secure each guide assembly to the block housing by two 3/8-inch bolts, nuts and lock washers
- F. Single-Purchase Counterweight Arbors:
  - 1. Loading capacity: 1800
    - a. Leave an additional 10-inch clear space above a full load of weights for easy loading.
  - 2. Arbor Head construction:
    - a. 5/16-inch-thick steel plates or 1/4-inch steel plate
    - b. Form into a channel with 3-inch sides
      - 1) Two vertical side legs and one vertical end leg.
      - 2) Weld leg joints
    - c. Provide side legs with smooth holes to receive anchor shackles.
  - 3. Connect lead cable from battens to shackles with thimbles and Nico-Press sleeves or two wire rope clips
    - a. Dress tail of cable with tape
  - 4. Arbor Bottom construction:
    - a. Similar construction as arbor tops or of 3-inch 7.1#C ship channel or of flat bar 1/2 x 3 inches bent to join with 3/8 x 3-inch vertical flat tie bar.
  - 5. Provide head and bottom members with 7/16-inch drop forged eye bolts welded in the center to receive 3/4-inch purchase line.
    - a. Connect purchase line to forged eye with thimble and knot
      - 1) Dress tail with tape.
  - 6. Provide a minimum of two UHMW plastic guide assemblies
  - 7. Connect top and bottom together by two 3/4-inch diameter vertical ASTM A36 steel bars threaded at their ends only.
    - a. At the top of the arbor, provide the rods with two nuts on top of head and one nut at bottom of head
    - b. Tap the bottom plate holes to receive 3/4-inch threaded rods. Provide one 3/4-inch full nut below the bottom member.
    - c. No nuts are acceptable on tops of arbor bottoms except when ship channel is used.
    - d. Provide one thumb screw on each rod clamping collar for locking weights in place
    - e. Provide at the bottom end of the onstage 3/4-inch rod, a 1/2-inch drop forged eye nut to be equal to Chicago Hardware No. C-181-A, tapped to fit 3/4-inch rod.
  - 8. Spreader plates:
    - a. Minimum three per arbor
    - b. 1/8-inch x 2-inch flat bar steel
    - c. Affix signs to the arbor back plate that reads:
      - d. "CAUTION: Locate spreader plate here." at 2-foot intervals
  - 9. At the top and bottom of each arbor, provide 1/2 inches high line set ID numbers. Adhesive "stick-on" number labels may be used
- G. Pipe Battens:
  - 1. 1-1/2-inch NPS, schedule 40 steel pipe
  - 2. Splices:
    - a. Sleeve splice all joints

- b. 18-inch long, 9 inches extending into each pipe.
      - c. Bolt through the sleeve with two 3/8 inches x 1-inch hex head, grade 5 bolts.
        - 1) Drill holes in pipes and sleeves so that all pipe sections are interchangeable
    3. Color: Black (painted)
      - a. Paint the last 12 inches at each end of the truss and pipe batten white or provide yellow plastic end caps.
      - b. Mark centerline with a 1/2-inch painted yellow line around the circumference of the bottom pipe
      - c. Paint 1/2-inch-wide white lines at 1-foot increments marked around the circumference of the batten, starting at center and working out to the ends
    4. At each pick-up point, provide a red tape mark on each side of the trim chain for the full circumference of the top pipe.
    5. Line Set Numbers:
      - a. Mark each batten with its line set number
      - b. Color: white
      - c. 1-inch-high numerals
      - d. Mark on the top and bottom of each batten 18 inches from each end, and 12 inches stage left of the centerline mark
    6. Use trim chains for pickup cable batten connections
  - H. Pipe Batten Extensions:
    1. Ten pipe extensions.
    2. Length: 6 feet
    3. 1-inch NPS schedule 80 steel pipe
    4. Must sleeve within the 1-1/2" I.D. pipe batten.
    5. Terminate extensions in a pipe collar welded in place and ground smooth to act as an end stop
    6. Paint extensions white from end – 4 feet
      - a. Paint the last 2 feet bright red
    7. Install extensions on line sets designated by the Owner's representative
  - I. Pickup Cables:
    1. Use 1/4-inch 7 x 19 utility cable
    2. Breaking Strength: 7,000 lbs.
    3. free of oil
    4. Certification required.
  - J. Trim Chains:
    1. Use either J.R. Clancy Grade 63 AlphaChain or SECOA STC chain
      - a. 3,250 pounds working load
      - b. Must meet OSHA 1910.184(e)(5) – Sling use,
      - c. Length: 36 inches
      - d. Use at the batten end of the pickup cables.
    2. One end of the trim chain shall connect to pickup cable with thimbles and Nico-press sleeves.
    3. Fit the other end with a 1/4-inch screw-pin shackle
  - K. Alternative batten clamp Trim Chains:
    1. Assemble trim chain with 1/4-inch screw-pin shackle, steel batten clamp and either J.R. Clancy Grade 63 AlphaChain or SECOA STC chain,
    2. 3,250 pounds working load
    3. Must meet OSHA 1910.184(e)(5) – Sling use.
  - L. Purchase Lines:
    1. 3/4-inch diameter rope
    2. Multiline II synthetic rope free from slivers and foreign materials and in one continuous length.
    3. No splices will be accepted
  - M. Counterweights:
    1. Standard "U" slotted type flame cut steel,
    2. Width: 6 inches
    3. Grind all edges smooth
    4. Cut two opposite corners at 45-degree angle to allow for ease of removal with alternately stacked counterweights.
    5. Insert sufficient weight in each arbor to balance the empty pipe and paint the exposed edges of these weights "safety yellow".

- N. Arbor Guide Tracks:
    - 1. Use 1-1/2 inches x 1-1/2 inches x 3/16 inches tee-steel or J-bar aluminum extending from the stage level to the underside of the head block beams.
    - 2. Space tracks as shown on centers.
  - O. Stop Bumpers:
    - 1. Use 1-3/4 inches x 1-3/4 inches x 3/16 inches angle irons bolted to the tee tracks.
    - 2. Bolt 2-inch x 2-inch hardwood to the angle iron.
    - 3. On the arbor contact surface of the hardwood, mount 1/2-inch neoprene rubber to cushion the arbor impact.
  - P. Wall Battens:
    - 1. Use the same angle iron as the upper and lower stop bumpers
    - 2. Mount on 5-foot centers
    - 3. Weld wall battens in place to tilt wall imbeds provided by the General Contractor
    - 4. Fasten tee bars and hold parallel using "U" shaped clips at each wall batten
  - Q. J-Bar Connections:
    - 1. All connections of wall knees, wall battens, stop battens, and tee guides shall have 3/4-inch slotted holes to permit perfect vertical alignment.
    - 2. Use 5/16-inch x 7/8-inch machine bolts for all tee connections.
      - a. For all other connections, use 3/8-inch x 1-1/4-inch bolts
    - 3. Use a flat washer and a lock nut at all slotted connections
      - a. Use lock washers at all other connections
  - R. Locking Rails:
    - 1. Location: at the stage floor level and at the fly gallery level
    - 2. Construction:
      - a. Drill to receive rope locks 8 inches on center
      - b. Use 3 inches x 4 inches x 1/4-inch steel angle for the rope lock
        - 1) Supported 2-foot 6-inches above the stage floor by C4 x 7.24 steel channel legs with diagonal bracing.
      - c. Base plates on each leg for floor mounting and gussets for rigidity.
    - 3. Bolt leg base plates through the floor slab or weld to structural steel for maximum uplift of 400 pounds per linear foot on the purchase lines through the rope locks.
    - 4. On each locking rail, provide cards and mountings for further identification of line sets
    - 5. Provide permanent line set number labels on the locking rail above the ID card slots
      - a. Do not place these lineset number labels in the line set identification cards
  - S. Rope Locks:
    - 1. Construction:
      - a. Housings made out of a material having ductile properties that will deform plastically without fracturing
      - b. Provide an adjustment mechanism on the rope lock for adjustment of the clamping members for worm ropes or ropes of differing diameters
      - c. Encapsulate handle in plastic
      - d. 50 pounds capacity
      - e. Contains an integral mechanism designed to prevent accidental release
    - 2. Operation:
      - a. Holds locked position until manually released
    - 3. Position Rope Locks to impose minimal wear on the operating line as it passes through the system.
- 2.7 INDEX STRIPLIGHTS AND SUPPORT OUTRIGGERS
- A. Provide three sets of two circuit LED index striplights in lengths shown on the drawings and suspended on chains above the stage level locking rail
    - 1. Provide sufficient chain to allow potential lowering of each striplight 2 feet.
    - 2. Wire lamps on two circuits,
      - a. One for a blue-wash
      - b. One for a white-wash.
    - 3. Provide LED lamps, in blue and warm-white.
  - B. Provide an outrigger assembly as shown on the drawings to support the index strip lights.
- 2.8 SINGLE PIN RAILS
- A. Furnish single pin rails in type and lengths shown on the drawings in locations shown on drawings

- B. Construction:
    - 1. 3 1/2-inch I.D. steel pipe
    - 2. Contains holes for removable steel belaying pins located every 12 inches on center on each rail.
    - 3. Designed to accept either a maximum anticipated load of 500# PLF or a point load of 1000# PLF in either an upward or downward direction, at the midpoint between each pin rail support.
  - C. Provide 48 belaying pins, each 20 inches long.
    - 1. Install 24 pins stage right and 24 pins stage left
- 2.9 LOADING BRIDGE POST AND CHAIN ARBOR GUARD RAILINGS
- A. Provide pipe or square tube posts to the loading bridge as shown on the drawings.
  - B. Provide rails at +30 inches and +42 inches AFF of 4/0 proof coil chain extending from post to post along the entire length of the arbor side of the loading bridge.
    - 1. One end of each length of chain shall be permanently attached to one post, and the opposite end of the chain shall have a 3/8-inch jaw and jaw turnbuckle and screw pin shackle.
      - a. Tape all cotter pins to eliminate all sharp edges
  - C. Tension each chain rail to eliminate swag
  - D. Withstand a force of minimum 200# in any direction
- 2.10 SIGNAGE
- A. Provide and install signs with white background and 3/8-inch-high red letters to be mounted on the wall adjacent to the tee bar battery on the stage level, fly gallery level, and loading bridge level.
    - 1. The signs shall read as shown on the drawings.
    - 2. "Date of Last Inspection" and "Date of Next Required Inspection" information shall be in erasable marker.
  - B. Provide numbered labels to identify each line set at loading bridge level, either on the face of the kickplate, on the head block beam or suspended below the head block beam.
- 2.11 MISCELLANEOUS EQUIPMENT
- A. Provide the following equipment, stored at grid iron level:
    - 1. Eight 8-inch diameter upright head blocks
      - a. Meet the same requirements as the head blocks listed in above with two sheaves, each grooved for one 5/8-inch diameter rope line.
    - 2. Eight 8-inch diameter upright loft blocks
      - a. Meet the same requirements as the loft blocks listed above with sheaves grooved for one 5/8-inch diameter rope line
  - B. Provide the following equipment, stored at fly gallery level with one half at stage left and one half at stage right:
    - 1. Two 1200-foot coils of first quality 5/8-inch diameter Multiline II synthetic rope
    - 2. Four 100# sandbags, filled, each with snap hooks with minimum 5/8-inch rope capacity.
    - 3. Eight 50# sandbags, filled, each with snap hooks with minimum 5/8-inch rope capacity.
    - 4. Eight 25# sandbags, filled, each with snap hooks with minimum 5/8-inch rope capacity.
    - 5. Eight "Sunday hitches", each made of an 18-inch diameter loop of 1/4-inch 7x19 wire rope held with two Nicopress sleeves.
    - 6. Eight 30-inch-long lengths of 1-1/2-inch NPS schedule 40 steel pipe to weight the spot lines onstage.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Examine all conditions under which all presentation area rigging items shall be installed and notify the General Contractor in writing of any condition detrimental to the proper and timely completion of the work.
- B. Contractor is solely and exclusively responsible for the satisfactory completion of this rigging system
  - 1. Supply all tools required for the successful installation of the equipment herein.
  - 2. Storage of all equipment and tools during the period of installation and for collecting and removing from the job site all packing materials, trash, scrap materials, etc.
- C. The Stage Rigging Contractor shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.

- D. Prior to the completion of the installation, the Contractor shall notify the General Contractor and Architect to schedule an inspection of the system.
  - 1. At the time of the inspection, the Stage Rigging Contractor shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Architect and/or the Owner's representatives.
  - 2. Repair or replace equipment that does not meet specifications with new equipment
    - a. Reschedule inspection under the same conditions listed previously
  - 3. Remove all temporary to permit full operation and access to all equipment.
  - 4. All temporary equipment shall be removed to permit full operation and access to all equipment.
  - 5. Final review will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

### 3.2 INSTALLATION SUPERVISION

- A. Installation of the rigging systems shall be supervised by the Contractor's own experienced superintendent having extensive experience in installing work of this kind.
  - 1. Superintendent shall be an Entertainment Technician Certification Program (ETCP) Certified Rigger - Theatre.
    - a. Contractor shall provide the Architect with a copy of the superintendent's ETCP certification and shall make a copy of this certification available on the job site for the length of the installation.
  - 2. An ETCP Certified Rigger - Theatre shall be present at all times during the rigging system installation.
- B. The same individual shall remain in charge of the work throughout the installation of the rigging system until work is completed excepting only the intervention of circumstances completely beyond the control of the Stage Rigging Contractor.
- C. The superintendent shall represent the Rigging System Contractor and all directions given to him shall be binding as if given to the Rigging System Contractor.
  - 1. The Rigging System Contractor may require the Owner to confirm such directions in writing.

### 3.3 FIELD QUALITY CONTROL

- A. Rigging System shall be installed in accordance with OSHA Safety and Health Standards and all local codes. All welding shall be in full compliance with the most recent edition of the Structural Welding Code (ANSI / AWS D1.1).
- B. All equipment shall be installed in locations shown on Construction Drawings and shall be installed plumb, straight and true and shall function as designed.
- C. All components shall be installed to prevent abrasion of moving items against any part of the building structure or other equipment.
  - 1. Sheaves shall be so aligned as to provide fleet angles of the cables not exceeding 2 degrees.
  - 2. Provide mule blocks, cable rollers and guides as required to provide proper alignment and movement around obstructions.
- D. Eyes at cable terminations shall be formed over thimbles of correct size.
- E. The Stage Rigging Contractor shall perform all drilling and fitting required in the setting of materials and all cutting and fitting required in the fitting of materials to the adjoining work of other Contractors.

### 3.4 OWNER TRAINING

- A. Contractor's installation superintendent shall perform owner training
- B. Schedule instruction with the Owner's designated representatives.
- C. Provide all O&M materials, as designated in this Specification, at the time of training
- D. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
  - 1. Instruction shall not necessarily follow immediately after the system check-out and activation
- E. Provide up to twelve hours of owner training to include the following:
  - 1. Up to eight hours of instruction shall cover the safe and proper operation of the equipment, including limit switch placement and adjustment, use of the control panel, etc., to the Owner's designated representative.

2. An additional four hours of training shall be dedicated to walking up to six users through an ANSI inspection of one lineset of each type.
  - a. ANSI inspection training shall cover what to look and listen for, how to identify common problems in each rigging system, and when a problem needs to be addressed immediately by a professional rigger.
- F. Instruction, at Owner's digression, may occur in multiple time blocks.
  1. If training is non-continuous, provide one form for each training segment.
- G. Provide written documentation of Owner training to the Owner upon completion.
  1. Form to include:
    - a. The date, time, and location of training.
    - b. Name, title, company and signature of trainer.
    - c. Name, title, and signature of all participants.
    - d. Topics covered at training.
- H. Training may be video and audio recorded by the owner at the owner's expense.

END OF SECTION 11 61 36

## SECTION 11 61 39

### FIRE SAFETY CURTIAN

#### PART 1 - GENERAL

##### 1.1 WORK OF THIS SECTION

- A. This Section includes all labor, materials, equipment, and services necessary to furnish and install the Fire Curtain System as shown on the drawings and/or specified herein, including but not limited to the following:
  - 1. A motorized, straight lift, automatically closing fire curtain
  - 2. associated rigging and release line as indicated on the drawings and
  - 3. Meet all requirements applicable codes including NFPA and IBC.
- B. Related work in other Sections:
  - 1. 116133 – Motorized Rigging
  - 2. 116136 – Counterweight Rigging
  - 3. 116123 – Theatrical and Acoustic Drapery

##### 1.2 SUBSTITUTIONS

- A. Substitutions are allowed when the substitution improves the quality, decrease installation time, or reduce cost.
  - 1. Submit a proposal that clearly outlines construction features of the product so that true and accurate comparisons may be made.
    - a. Samples of the proposed substitution item/s may be requested by the Architect and/or Owner for evaluation
- B. No product bid which deviates from the details of the Construction Documents will be considered unless such deviation has been approved in advance by the Architect.

##### 1.3 PROJECT CONDITIONS

- A. Provide all new equipment of the latest design
- B. No extras will be allowed due to the Contractor's misunderstanding of the work involved or its lack of knowledge of any field conditions due to failure to make accurate field measurements or a thorough investigation of the job site

##### 1.4 SUBMITTALS

- A. Submit shop drawings for review by the Architect before fabrication can begin. Such review does not relieve the Contractor of the responsibility of providing equipment in accordance with this Specification.
- B. Shop Drawings:
  - 1. Show dimensions, sizes, gauges, thicknesses, finishes, joining, attachments and relationship of work to adjoining construction.
  - 2. Clearly show power, wire, and conduit requirements for all work to be provided by the Contractor.
  - 3. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
  - 4. Where other materials must be set to exact locations to receive rigging, furnish assistance and directions necessary to permit other trades to locate their work.
  - 5. Where welded connections, concrete or masonry inserts are required to receive work, show exact locations required and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts.
  - 6. Show locations of all lubrication points.
  - 7. Include engineering and load calculations as well as stamp and seal of a registered professional engineer.
  - 8. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.
  - 9. Include a copy of the installation superintendent's ETCP Certified Rigger - Theatre certification. A copy of the installation superintendent's ETCP certification shall be available on the job site for the length of the installation.

- C. Any deviation from this Specification shall be clouded and noted in letters a minimum 1/4-inch high.
    - 1. In order for a deviation to be considered, it must upgrade the quality of the equipment or respond to a field condition.
  - D. The Stage Rigging Contractor shall, if requested by the Owner or Architect, furnish satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of hardware to be used in this contract.
    - 1. Owner retains the samples until such time that this contract has been completed and accepted.
  - E. Upon completion of installation, Contractor shall provide Operation and Maintenance (O&M) manuals that shall include record shop drawings, parts lists, operational instruction, service/maintenance recommendations, component working load limits, etc.
    - 1. One printed "hard" copy of the O&M manual
    - 2. Two flash drive electronic versions of the O&M manual
- 1.5 WARRANTY
- A. Assure that the rigging is properly installed, free of defects in materials and workmanship and shall provide a warranty on all equipment and workmanship provided under this contract for a period of two years from the date of the final acceptance.
  - B. During the warranty period, repair or replacement of defective materials and faulty workmanship shall be provided, at no cost to the Owner, within ten days of written notification of defects(s).
  - C. Post Installation Safety Inspection:
    - 1. One year after the date of final acceptance by the Owner, the installation superintendent shall return to the job site to conduct a thorough inspection of the rigging installation.
      - a. Check all bolts and tighten as required, inspect all cable connections and give all items a thorough safety inspection in compliance with ANSI E1.47, Entertainment Technology – Recommended Guidelines for Entertainment Rigging System Inspections.
      - b. Repair or replace all damaged items
      - c. If the original superintendent is unavailable either because the superintendent no longer works for the contractor or due to issues fully beyond the control of the contractor, then an alternate rigger superintendent shall perform the inspection, under the following conditions:
        - 1) Be ETCP-RT certified
        - 2) Have experience supervising installation on projects of similar scope and scale
    - 2. The Contractor is responsible for all materials, superintendent labor, transportation and living expenses for this work at no additional cost to the Owner.
      - a. Conduct inspection and repair work during normal working hours at a time mutually agreed upon by the Owner and the Contractor.
    - 3. Provide the Owner and Architect with a written report stating the findings of the inspection within two weeks of completion of the inspection.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. Manufacturers for work in this section:
  - 1. Weiss Inc.  
Fairview, NJ  
(201) 402-6500  
<https://www.iweiss.com/>
  - 2. J.R. Clancy Inc.  
Syracuse, NY  
(315)451-3440  
<https://www.jrclancy.com/>
  - 3. Texas Scenic Co.  
San Antonio, TX  
(210) 684-0091  
<https://www.texasscenic.com/>
- B. The Contractor shall have been continuously engaged in the production of theatrical stage rigging equipment for at least fifteen years.



- C. The Contractor shall have installed a total of not less than five installations of equal or greater scope to system specified herein, which have been in service for a minimum of one year and a maximum of ten years.
  - 1. Each of the listed stage rigging installations shall be in service in fully professional commercial theatres being operated by professional technicians.
- D. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
  - 1. 116133 – Motorized Rigging
  - 2. 116136 – Counterweight Rigging

## 2.2 GENERAL

- A. Curtain sized as shown on the drawings and operate from stage right
  - 1. Verify dimensions in the field
- B. Operate curtain within smoke pockets
- C. Provide an approved curtain of non-combustible material designed and installed to protect against the passage of flame, smoke, and hot gases in the proscenium opening
- D. The curtain shall be operated by an automatic heat activated device to descend instantly and safely and to completely close the proscenium opening, and, by an auxiliary operating device, to permit prompt and immediate manual closing of the proscenium opening.
  - 1. Duration and speed of the automatic closing function of the fire curtain shall meet all applicable codes and standards, including NFPA, IBC, and ANSI E1.22.
  - 2. Provide electric fusible links or electronic release mechanism that, upon receiving signal from fire alarm system, lowers the fire curtain.
- E. Provide all items not intentionally omitted to make the fire curtain installation complete in all respects to conform with applicable NFPA and Building Codes and Regulations.

## 2.3 MATERIALS

- A. Ferrous materials and accessories shall conform to the following ASTM and ANSI standard specifications:
  - 1. Standard structural steel shapes and plates:
    - a. ASTM A-36.
  - 2. Miscellaneous steel items:
    - a. ASTM A-283, grade optional.
  - 3. Steel pipe:
    - a. ASTM A-53
  - 4. Gray iron castings:
    - a. ASTM A-48, Class 30 unless otherwise specified.
  - 5. Malleable iron castings:
    - a. ASTM A-47
  - 6. Bolts and nuts:
    - a. B18.2.1&2
  - 7. Welding electrodes shall be as permitted by AWS Code D1.0.
- B. Wire Rope and Fittings
  - 1. Wire rope shall be 7x19 construction, utility cable, sized as required, that meets Federal Specification RR-W-410E.
    - a. Damaged or deformed cables shall not be used.
  - 2. Cable fittings shall be Nicopress copper sleeves or forged steel clips and conform to wire rope manufacturer's recommendations as to size, number and method of installation.
- C. Aluminum Materials and Accessories
  - 1. Thicknesses, gauges and tempers of aluminum products shall be as required for proper forming operations and to meet structural standards.
  - 2. Aluminum Castings: 214 or 356 alloy as per strength requirements.
  - 3. Fasteners: Include bolts, nuts, washers, screws, nails, rivets and other fastenings necessary for proper erection and/or assembly of aluminum work.
  - 4. Fabrication shall be by AWS certified welders.
- D. Finishes for Items Without Factory Finish
  - 1. Welds, burrs and rough surfaces on all interior ferrous metals shall be ground smooth and the completed assembly cleaned and all metal surfaces shall be given a minimum one coat of finish paint.

2. No painted finish shall be required on aluminum finishes.
3. All exposed fastenings shall match color and finish of adjacent material.

E. Pipes

1. Provide a 2-inch NPS, schedule 40 steel pipe batten placed in the pocket at the top of the curtain
2. Provide a 2-inch NPS schedule 40 steel pipe batten in the bottom pocket of the curtain.

2.4 SAFETY STANDARDS

A. In order to establish minimum standards of safety, the following factors shall be used:

1. Cables and fittings: 8:1 Safety Factor
2. Terminating hardware: 5:1, or not exceeding WLL, whichever is more restrictive.
3. Trim chain assembly: 5:1, or not exceeding WLL, whichever is more restrictive.
4. Batten clamps: 5:1, or not exceeding WLL, whichever is more restrictive.
5. Motors: 1.0 Service factor
6. Gearboxes: 1.25 Mechanical Strength Service Factor
7. Cable bending ratio: Sheave diameter is 30 times diameter of cable
8. Tread pressures: 500# for cast iron, 900# for Nylatron, 1000# for steel
9. Maximum fleet angle: 1-1/2 degrees
10. Steel: 1/5 of yield
11. Bearings: L10 life of 2000 hours at two times required load at full speed
12. Bolts: Grade 5 or better, plated

2.5 STRAIGHT LIFT FIRE CURTAIN

A. Construction:

1. Non-combustible, non-asbestos, non-carcinogenic, silica-based cloth of sufficient weight and composition
  - a. Meets or exceeds the requirements set forth in all applicable codes and standards, including NFPA, IBC, and ANSI E1.22
  - b. Continuous length of fabric running vertically
    - 1) No horizontal seams
  - c. Minimum 1" overlap with double rows of stitching on seams.
  - d. Sew with flame retardant thread that has the same or greater thickness than the yarns in the cloth

B. Provide minimum 6-inch pockets of double thickness at the top and bottom of the curtain for the pipe battens.

1. On the back of the bottom pocket provide openings at each end, at center line, and 21 feet left and right of center line making installation of bottom pipe easier.

C. At the bottom of the curtain, provide a 3-inch-thick yielding pad of non-combustible material to form a seal when the fire curtain is in the closed position.

1. The yielding pad shall be covered with a double thickness of cloth.

D. Wire Guides

1. At each side of the fire curtain provide a minimum 6-inch turn back hem
2. Hold the sides of the fire curtain to the guide cables with bronze guides, placed not more than 18 inches apart
  - a. Fasten each guide to the curtain with a minimum of three bolts or rivets.

E. Above the proscenium opening, provide a smoke seal between the fire curtain and the wall.

1. This seal shall be of sufficient width to bear on the curtain when the curtain is in the closed position.
2. Attach smoke seal to the upstage side of the proscenium wall

2.6 MOTORIZED FIRE SAFETY CURTAIN WINCH

A. Construction:

1. One motorized winch assembly with integrated centrifugal speed governor to control curtain descent containing the following:
  - a. Built-in metal safety enclosure
  - b. Basic control station
  - c. Provisions for attachment of clew guide cables.

- B. Winch to hold curtain in storage position by means of a brake with release attached to the emergency release line. Use 1/4-inch 7x19 Small Diameter Specialty Cord for drive line. Aircraft cables are acceptable.
  - 1. Virtually maintenance free winch for the user's ease of operation.
  - 2. Utilize Four total factory-wired and tested limit switches, for both over travel and operational limits, as standard.
  - 3. Winch shall comply with NFPA 80, Chapter 20 Fabric Fire Safety Curtains Standard.
  - 4. Include winch as standard equipment
- C. Capacity:
  - 1. 1250 pounds as standard
  - 2. If additional capacity is necessary, augment with a lattice-type guide track
- D. Lattice-Type Guide Track:
  - 1. Long enough to accommodate the counterweight arbor plus the travel of the curtain
  - 2. Terminate wire ropes at the top of the arbor with jaw and eye turnbuckles
    - a. Provide thimbles to accommodate the cable and fit through the turnbuckle's eye
  - 3. Cable shall be secured with proper size and number of wire rope clips or Nicopress sleeves
  - 4. Provide turnbuckles rated for a safety factor of not less than 5
    - a. Long enough to allow six inches of adjustment after installation
    - b. Use jam nuts or "mouse" with wire to prevent rotation
  - 5. Attach the lattice track to the wall along its length every 4-feet minimum, using 1/4-inch x 2-inch formed brackets
    - a. Provide all materials required to extend the lattice track out from any uneven proscenium wall conditions as required
  - 6. Size arbor to properly counterbalance weight
    - a. Provide two locking stop collars and a minimum of three steel flat bar spacer plates on the arbor
  - 7. Provide counterweight in various thicknesses to properly counterbalance the fire curtain plus
  - 8. Provide spring stop bumpers at the bottom of the lattice track
- E. Control system:
  - 1. "Push-to-operate" style system
    - a. Attach directly to the winch enclosure
    - b. Works in tandem with wall mount release boxes
  - 2. Maintained E-stop button shall operate a line contactor, which removes power completely from the reversing contactor and controls.
- F. Low voltage controls:
  - 1. UL listed
  - 2. Factory wired and tested
- G. Power shall not be required for emergency operation of Fire Curtain release system

## 2.7 EMERGENCY CONTROL LINE SYSTEM

- A. Furnish and install a complete fire or emergency control line system, consisting of the following:
  - 1. Minimum 3/32-inch 7x19 utility cable
  - 2. Install one line on each side of the proscenium opening
- B. Extend line system up both sides and above the proscenium opening.
- C. Use a mechanical quick-release device that can be easily reset for any attachment to the emergency control line

## 2.8 MANUAL EMERGENCY DEPLOYMENT

- A. Activate of one of two mechanical quick-release assemblies
  - 1. one on each side of the proscenium opening.
- B. Activation:
  - 1. Pull a minimum 1-1/2-inch diameter red ring, attached to a quick-release pin that is pinned through two steel plates housing a minimum 1-inch diameter ring that is securely attached to the emergency release line.
- C. Quick release mechanisms shall be such that they can quickly and easily be reset in the event of erroneous activation.

- D. Other similar activation assemblies that are positive in nature and meet the basic criteria of the quick release system detailed above may be used.

## 2.9 ELECTRONIC EMERGENCY DEPLOYMENT

- A. Provide one electronic mechanism which will release the fire line automatically upon signal from alarm system.
  - 1. Mechanism shall allow for test release of the Fire Curtain fire line. If electric fusible links are provided, provide five additional links.
  - 2. If an electrically held mechanism is provided, provide a battery and "trickle" charger to supply power to the mechanism to prevent release of fire curtain in the event of a power failure.

## 2.10 SIGNAGE

- A. Display appropriate signs in English near each emergency control line release mechanism.
  - 1. For the release system listed above, the sign shall read:
- B. "IN CASE OF FIRE, PULL RED RING TO LOWER FIRE CURTAIN AUTOMATICALLY!" with an arrow pointing to the location of the ring.
- C. Provide and install signs with white background and 3/8-inch-high red letters to be mounted on the wall on the stage level, fly gallery level, and loading bridge level at a position that is conspicuous to workers performing rigging work.
  - 1. The signs shall read as shown on the drawings.
  - 2. Use erasable marker for "Date of Last Inspection" and "Date of Next Required Inspection" information

## 2.11 SMOKE POCKETS

- A. Construction:
  - 1. 18 inches deep
  - 2. Minimum 1/4-inch-thick structural steel shapes and plates with a bolted construction using minimum 3/8-inch Grade 5 bolts on minimum 4-foot centers to attach plates to the steel shapes for the entire height of the smoke pocket.
  - 3. Begin at 6 inches off stage from the proscenium opening as shown on the drawings
  - 4. Color: black
- B. Vertically extend smoke pockets from the stage floor to the underside of the grid iron
  - 1. Securely fasten to the upstage side of the proscenium wall with minimum 1/2-inch diameter Grade 5 bolts in anchors on minimum 4-foot centers.

## 2.12 RIGGING

- A. Head Block
  - 1. Head Block Construction:
    - a. Sheave:
      - 1) 16-inch diameter
      - 2) Grooved to conform to rope and cable manufacturer's recommendations
      - 3) Machined, faced, lathe turned and grooved for the respective number of 1/4-inch cables and one 3/4-inch rope
      - 4) Equip with at least six pipe spacers, through bolted to the side plates, to prevent cables escaping from the sheave grooves
    - b. Bearing:
      - 1) At least 1-inch diameter hub
      - 2) Tapered roller bearings with felt seals press fitted in the head block bore
    - c. Shaft:
      - 1) Keyed to one side plate to prevent the shaft from rotating
      - 2) Thread the opposite end of the shaft and equip with "Flexloc" self-locking nut
    - d. Side Plates:
      - 1) 10-gauge steel
      - 2) Weld to the base angle
    - e. Mounting Angle Iron:
      - 1) Two support angle irons for mounting to building structure
        - a) Sized for the specific load
      - 2) Minimum of two bolts per base angle or mounting clips of sufficient size

2. Component parts of head blocks shall meet the same requirements as head blocks listed in 116136 – Counterweight Rigging
  3. Install head block in location as shown on drawings
  4. Align head blocks so that each groove, its center and sides, remains in the same vertical axis when the sheave is rotated.
  5. Provide additional support steel to elevate the head block as required.
- B. Loft Blocks
1. Loft Block Construction:
    - a. Upright
    - b. Nylon
    - c. Sheave:
      - 1) 12-inch diameter
      - 2) Grooved to conform to rope and cable manufacturer's recommendations
      - 3) Machined, faced, and bored for shaft and bearings
    - d. Bearing:
      - 1) At least 2-inch diameter hub
      - 2) Two tapered roller bearings in place operating on a 1/2-inch diameter steel shaft or sealed precision ball bearings on a 5/8-inch diameter steel shaft
    - e. Shaft:
      - 1) Keyed to one side plate to prevent the shaft from rotating
      - 2) Thread the opposite end of the shaft and equip with "Flexloc" self-locking nut
    - f. Side Plates:
      - 1) Minimum 11-gauge steel
    - g. Mounting Angle Iron:
      - 1) Two support angle irons for mounting to building structure
        - a) Sized for the specific load
      - 2) Minimum of two bolts per base angle or mounting clips of sufficient size
    - h. Cables:
      - 1) 1/4-inch 7x19 steel pick-up cables
      - 2) Attach cables to the counterweight carriage using turnbuckles, cable thimbles and wire rope clips or Nicopress sleeves
  2. Component parts of loft blocks shall meet the same requirements as loft blocks listed in 116136 – Counterweight Rigging
  3. Install loft blocks at spacing as shown on drawings
- C. Safety Chain
1. Provide 1/4-inch proof coil safety chains leading from the top batten to custom mounting steel as required.
    - a. Adjust chains so that they support the curtain when it is lowered, and the bottom batten is resting on the yield pad supported by the floor

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Examine all conditions under which all presentation area rigging items shall be installed and notify the General Contractor in writing of any condition detrimental to the proper and timely completion of the work.
- B. Contractor is solely and exclusively responsible for the satisfactory completion of this rigging system
  1. Supply all tools required for the successful installation of the equipment herein.
  2. Storage of all equipment and tools during the period of installation and for collecting and removing from the job site all packing materials, trash, scrap materials, etc.
- C. The Stage Rigging Contractor shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.
- D. Prior to the completion of the installation, the Contractor shall notify the General Contractor and Architect to schedule an inspection of the system.
  1. At the time of the inspection, the Contractor shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Architect and/or the Owner's representatives.
  2. Repair or replace equipment that does not meet specifications with new equipment
    - a. Reschedule inspection under the same conditions listed previously

3. Remove all temporary to permit full operation and access to all equipment.
4. Final review will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

### 3.2 INSTALLATION SUPERVISION

- A. Installation of the rigging systems shall be supervised by the Rigging System Contractor's own experienced superintendent having extensive experience in installing work of this kind.
  1. Superintendent shall be an Entertainment Technician Certification Program (ETCP) Certified Rigger - Theatre.
    - a. Rigging System Contractor shall provide the Architect with a copy of the superintendent's ETCP certification and shall make a copy of this certification available on the job site for the length of the installation.
  2. An ETCP Certified Rigger - Theatre shall be present at all times during the rigging system installation.
- B. The same individual shall remain in charge of the work throughout the installation of the rigging system until work is completed excepting only the intervention of circumstances completely beyond the control of the Contractor.
- C. The superintendent shall represent the Contractor and all directions given to him shall be binding as if given to the Contractor.
  1. The Contractor may require the Owner to confirm such directions in writing.

### 3.3 FIELD QUALITY CONTROL

- A. Install rigging system in accordance with OSHA Safety and Health Standards and all local codes. All welding shall be in full compliance with the most recent edition of the Structural Welding Code (ANSI / AWS D1.1).
- B. Install all equipment in locations shown on Construction Drawings
  1. Install plumb, straight and true and function as designed.
- C. Install all components to prevent abrasion of moving items against any part of the building structure or other equipment.
  1. Align sheaves as to provide fleet angles of the cables not exceeding two degrees.
  2. Provide mule blocks, cable rollers and guides as required to provide proper alignment and movement around obstructions.
- D. Form cable termination eyes over thimbles of correct size
- E. The Contractor shall perform all drilling and fitting required in the setting of materials and all cutting and fitting required in the fitting of materials to the adjoining work of other Contractors.

### 3.4 OWNER TRAINING

- A. Contractor's installation superintendent shall perform owner training
- B. Schedule instruction with the Owner's designated representatives.
- C. Provide all O&M materials, as designated in this Specification, at the time of training
- D. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
  1. Instruction shall not necessarily follow immediately after the system check-out and activation
- E. Provide up to four hours of owner training to include the following:
  1. Up to two hours of instruction shall cover the safe and proper operation of the equipment, including limit switch placement and adjustment, use of the control panel, etc., to the Owner's designated representative.
  2. An additional two hours of training shall be dedicated to walking up to 6 users through an ANSI inspection of one lineset of each type.
    - a. ANSI inspection training shall cover what to look and listen for, how to identify common problems in each rigging system, and when a problem needs to be addressed immediately by a professional rigger.
- F. Instruction, at Owner's digression, may occur in multiple time blocks.
  1. If training is non-continuous, provide one form for each training segment.

- G. Provide written documentation of Owner training to the Owner upon completion.
  - 1. Form to include:
    - a. The date, time, and location of training.
    - b. Name, title, company and signature of trainer.
    - c. Name, title, and signature of all participants.
    - d. Topics covered at training.
- H. Training may be video and audio recorded by the owner at the owner's expense.

END OF SECTION 11 61 39

## SECTION 11 61 63

### ORCHESTRA SHELL

#### PART 1 - GENERAL

##### 1.1 WORK INCLUDED

- A. This Section includes all labor, materials, equipment, and services necessary to manufacture, deliver and install an Orchestra Shell System as shown on the drawings and specified herein, including but not limited to the following:
  - 1. Rolling acoustic towers.
  - 2. Overhead acoustic ceiling panels.
- B. It shall be the responsibility of the Orchestra Shell Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

##### 1.2 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related work in other Sections
  - 1. 116133 – Motorized Rigging
- C. Site Conditions: Contractor shall be responsible for verifying that the job conditions are ready to receive work in this section. Contractor must alert the General Contractor to any existing conditions that may adversely affect execution of work, so that resolution may be reached before commencement of installation.

##### 1.3 SUBMITTALS

- A. Submittals shall be according to the Conditions of the Contract and Division Specification Sections.
- B. Orchestra Shell Manufacturer shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.
- C. Shop Drawings shall be submitted and reviewed by the Architect before fabrication can begin.
  - 1. Such review does not relieve the Orchestra Shell Manufacturer of the responsibility of providing equipment in accordance with this Specification.
- D. Shop Drawings shall include layout, fabrication, and installation drawings showing product components in assembly with adjacent materials and products
- E. Shop Drawings shall show dimensions, sizes, weights, gauges, thicknesses, finishes, circuiting, joining, attachments, lubrication points, and relationship of work to adjoining construction.
- F. The Orchestra Shell Manufacturer shall, if requested by the Owner or Architect, furnish satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of equipment to be used in this contract.
  - 1. The samples shall be retained by the Owner until such time that all items contracted for have been installed and accepted.
- G. Upon completion of installation, Orchestra Shell Manufacturer shall submit three copies of an Operation and Maintenance manual which shall include as-built shop drawings, parts lists, operational instruction, maintenance recommendations, etc.
  - 1. One O&M manual shall be a printed hard copy.
  - 2. O&M manual shall also be provided in electronic format on two flash drives.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Delivery and installation of the Orchestra Shell System shall be as required in the Construction Documents.
- B. Factory-assemble and finish components prior to shipment.
- C. Deliver all materials to the job site suitably crated, packed and protected, and bearing the manufacturer's identification label and the nomenclature of the product(s) found in the carton.



- D. Orchestra Shell Manufacturer shall confirm delivery dates with the Owner/Construction Manager a minimum of 30 days in advance of scheduled delivery.

#### 1.5 WARRANTY

- A. The Orchestra Shell System shall conform to all applicable code requirements and shall be in conformance with industry standards of operations and practice.
  - 1. All materials, arrangements, and procedures shall comply with applicable OSHA requirements.
- B. The Orchestra Shell Manufacturer shall assure that the shell is properly installed, free of defects in materials and workmanship, and shall provide a warranty on all equipment and workmanship provided under this contract for a minimum two years from the date of the final acceptance by the Owner.
- C. During the warranty period, repair or replacement of defective materials and/or repairs of faulty workmanship shall be provided, at no cost to the Owner, within 10 days of written notification of defects(s).

#### 1.6 MANUFACTURERS

- A. Manufacturers and orchestra shell systems for work of this Section shall include:
  - 1. Wenger Corporation  
Owatonna, MN  
(800) 268-0148  
<https://www.wengercorp.com/>
  - 2. StageRight Crop.  
Clare, MI  
(989) 386-7393  
<https://stageright.com/>
  - 3. Sightline Commercial Solutions  
Minneapolis, MN  
(877) 215-7245  
<https://www.sightlinecommercial.com>
- B. Products of other manufacturers may be acceptable. However, manufacturers capable of providing specified products shall not, for convenience of their normal production methods, vary from the specification. Owner and Architect shall be the sole parties capable of determining bidder's compliance with specifications.

### **PART 2 - PRODUCTS**

#### 2.1 GENERAL

- A. The Acoustical Shell System shall consist of a full stage symphonic enclosure made up of rolling acoustic towers and overhead ceiling panels of sufficient size and density to control and reflect a maximum range of audible frequencies.
- B. The Shell System shall permit adjustment of reflector height and size to accommodate varying performance types and acoustical requirements. Acoustical panels shall be adjusted for angle and position to assure proper blending and projection of sound.
- C. The Shell System shall be designed to permit easy storage without dismantling.
- D. Orchestra shell towers and ceiling panels shall be stressed-skin composite type with a minimum of STC 23 to meet performance requirements
  - 1. The core of the towers and ceiling panels shall be 1-1/2" thick honeycomb material that has an open geometric pattern with cell walls vertical to panel skins and defined by alternating straight and sine wave layers.
    - a. Height of sine wave shall be 1/2", wall thickness shall correspond to 60lb. Kraft.
    - b. Bonding of core material to panel faces shall be with permanently cured urethane adhesive. Foam core materials and contact adhesives shall not be permitted.
- E. The face of the panels shall be 1/4" thick veneer hardwood plywood-faced medium density fiberboard stressed skin, in stain color selected by the Owner, with no exposed fasteners.
  - 1. Veneer shall be slip-matched and balance matched within the panel face.
  - 2. Finish shall be transparent, comparable to AWI custom grade acrylic lacquer.

- F. Provide deduct pricing for the following face panel alternates in lieu of the base project hardwood veneer plywood:
  - 1. For all panels, the face of the panels shall be plastic laminate top surface on 3/16-inch-thick hardboard stressed skin. Plastic laminate shall be in color selected by Owner, with no exposed fasteners.
- G. Back of each panel shall be 3/16" thick hardboard stressed skin, painted black.
- H. Straight panel edges shall be reinforced with extruded aluminum edge frame.

## 2.2 ROLLING ACOUSTIC TOWERS

- A. Acoustic towers shall be self-supporting, sound reflecting structures equipped with leveling, nesting "A-shaped" counterweighted bases and all hardware necessary to safely transport them to and from storage and lock into place when in "performance" position.
- B. Provide rolling wall towers in sizes as shown on the drawing.
- C. The wall tower base shall incorporate a counterweight of required weight to allow the towers to be moved safely about the stage.
- D. Structural frames shall incorporate tower wing hinges.
- E. Each tower shall be movable by transporter(s) that lock onto and lift the towers and allows them to move safely about the stage.
  - 1. Transporter shall allow towers to be moved in any direction.
- F. Each tower base shall have multiple, adjustable height levelers to allow for irregularities in the stage floor.
- G. Numbered markers shall be inserted flush with the stage floor indicating the location of each tower insuring consistent setup.
- H. Towers shall consist of three panels hinged together to obtain tower width as indicated on drawings.
- I. Designated side wall towers shall be equipped with doors for entering and exiting the performing area. Doorways shall have a minimum of 3'-0" wide open clearance.
  - 1. Doors shall have self-lubricating bearings for quiet operation.
- J. All instructions pertaining to the safe handling and operation of the towers shall be affixed to the tower in plain view.

## 2.3 OVERHEAD CEILING PANELS

- A. Stage overhead ceiling panels shall be sound reflective and include integral hardware for storage without interference with adjacent stage equipment.
  - 1. Ceiling panel shall be in sizes as shown on the drawings.
  - 2. Verify dimensions in shop drawings.
- B. Overhead panels shall be removable and also designed to fold vertically permitting storage on the stage rigging system. The overhead panel design shall allow each panel to be rotated by two people.
- C. Each overhead panel shall be equipped with necessary hardware to hang from a stage rigging lineset 1-1/2" NPS schedule 40 pipe truss batten.
  - 1. Method of attachment to truss batten must allow for installation or removal of each overhead panel.
  - 2. Hardware must permit angular adjustment from horizontal plane to 40 degrees.
  - 3. The hardware must also have the capability of locking the panels in a vertical position so that they may be stored on the batten.
- D. Integral LED light fixtures shall be incorporated into the ceiling to provide an even, general down light wash of the stage. Shop drawings shall reflect Shell Manufacturer suggested fixture locations.
  - 1. A mechanical tilt switch shall be provided at each light fixture to prevent accidental activation when the ceiling panel is in the vertical, storage position.
- E. When the panels are stored on the rigging batten, the maximum upstage/down stage storage space required shall be 14".
- F. Each complete row of ceiling panels shall not exceed the load capacity of the designated linesets. Verify weight in shop drawings.

**PART 3 - EXECUTION**

**3.1 GENERAL**

- A. Examine all conditions under which all Orchestra Shell items shall be installed and notify the Construction Manager in writing of any condition detrimental to the proper and timely completion of the work.
- B. Responsibility for the manufacture and installation of the orchestra shell shall rest solely and exclusively with the Orchestra Shell Manufacturer.
- C. The Orchestra Shell System Manufacturer shall be responsible for storage of all equipment and tools during the period of installation.
- D. The Orchestra Shell Manufacturer shall be responsible for collecting and removing all packing materials, trash, scrap materials, etc. from the job site.
- E. The Orchestra Shell Manufacturer shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.
- F. Prior to the completion of the installation, the Orchestra Shell Manufacturer shall notify the Construction Manager to arrange a date for observation of the system.
  - 1. At the time of the observation, the Orchestra Shell Manufacturer shall furnish sufficient personnel to operate all equipment and to perform adjustments as required by the Owner's representatives.

**3.2 INSTALLATION**

- A. Installation of the orchestra shell shall be supervised by the Orchestra Shell Manufacturer's own experienced superintendent having extensive experience in installing work of this kind.
- B. Orchestra shell overhead ceiling panels shall be installed on stage rigging single purchase, tee-bar guided line sets with motorized winch assist provided by the Rigging Manufacturer/Installer in locations shown on the drawings.
- C. Verify setting of units in performance and storage positions.
- D. Verify adjustability of units.
- E. Install and test integral lighting.
- F. The superintendent or other Orchestra Shell Manufacturer's representative shall provide minimum four hours of instruction to Owner's designated representative(s) in the safe, efficient operation of the Orchestra Shell System.

**3.3 FIELD QUALITY CONTROL**

- A. All equipment shall be installed in locations shown on Construction Drawings and shall be installed plumb, straight and true, and function as designed, safely and quietly, in accordance with manufacturer's recommendations and approved submittals.
- B. All lighting fixtures shall be focused by the Orchestra Shell Manufacturer to provide an even, general down light wash of the stage.
- C. Clean exposed surfaces of acoustical shells. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- D. Repair or replace defective work as directed by Architect upon inspection.

END OF SECTION 11 61 63

## SECTION 12 35 51

### MUSIC INSTRUMENT STORAGE CASEWORK

#### PART 1 - GENERAL

- 1.1 SUMMARY
- A. Section Includes: Music instrument storage casework.
- 1.2 SYSTEM DESCRIPTION
- A. Modular instrument storage casework with integral bases, adjustable levelers, and through-bolted fastening, enabling reconfiguration of unit layout.
- B. Storage Casework Component Load Capacities:
1. Storage Casework Wire-Grille Door Hinge: Each weld capable of resisting 400 lbf (1779 N) pull test without visible damage or permanent deformation.
  2. Storage Casework Full Grille Door Hinge= Full length door capable of supporting 315 lbs. Through open and close cycle without permanent damage.
- 1.3 SUBMITTALS
- A. Product Data: Manufacturer's data sheets, installation instructions, and maintenance recommendations.
- B. Shop Drawings: Prepared by manufacturer. Include elevations showing casework components, details of each condition of installation, and types and locations of hardware and fasteners. Show fabrication and installation details. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples: For each color and finish for each exposed casework component.
- D. Operation and Maintenance Data.
- E. Warranty: Submit sample meeting warranty requirements of this Section.
- 1.4 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years of experience in manufacture of similar products in use in similar environments. Obtain music education storage casework through one source from a single approved manufacturer.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle music education storage casework in accordance with manufacturer's recommendations. Ship to jobsite only after roughing-in, painting work, and other related finish work has been completed and installation areas are ready to accept casework and recommended temperature and humidity levels will be maintained during the remainder of construction.
- 1.6 COORDINATION
- A. Coordinate installation of blocking and supports in frame wall assemblies under work of other sections where required for anchoring of music education storage casework.
- 1.7 WARRANTY
- A. Special Warranty: Manufacturer's written warranty indicating manufacturer's intent to repair or replace components of music education storage casework that fail in materials or workmanship within 10 years from date of Substantial Completion. Failures are defined to include, but are not limited to, the following:
1. Fracturing or breaking of casework components including doors, panels, shelves, or hardware resulting from normal wear and tear and normal use other than vandalism.
  2. Delamination or other failures of glue bond of components.
  3. Warping of casework components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
  4. Failure of operating hardware.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Wenger Corporation.
- B. Basis-of-Design Product: Wenger Corporation; UltraStor Storage Cabinets.

### **2.2 MATERIALS**

- A. Particleboard: ANSI A208.1, minimum 43 lb/cu. ft. (689 kg/cu. m) density, with no urea formaldehyde added.
- B. Plywood: APA standards PS1-98 section 5.7.4 or 5.7.1 or ANSI /HPVA HP-1-2004 Panel provide with HDF skins to prevent grain telegraphing.
- C. Particleboard Thermoset Panels: Particleboard finished with thermally-fused polyester surfacing on both sides meeting performance properties of NEMA LD 3 for VGS grade, edge-banded, including the following:
  - 1. Surface Abrasion Resistance: Taber Wheel, 400 cycles, for solid colors.
- D. Polyethylene Shelves: High-density, one-piece, blow-molded or polyethylene, with radiused front edge, for abuse-resistant shelves.
- E. PVC Edge Banding: Radiused PVC extrusions, 3 mm thick.

### **2.3 INSTRUMENT STORAGE CASEWORK**

- A. General: Provide through-ventilating instrument storage casework meeting requirements in System Description and Performance Requirements Articles.
- B. Side Panels and Divider Panels: Particleboard thermoset panel with no urea formaldehyde added, 3/4 inch (19 mm) thick. Side panels machined to accept unit-to-unit through-bolting.
- C. Grille Doors: Bright basic steel wire, 5/16 and 3/16 inch (7.9 and 4.8 mm) diameter, with full 360 degree welds at T-joints.
- D. Panel Edge Banding: 3 mm thick, heat-bonded, with radiused and profiled edges and corners.
- E. Shelving: Sized with adequate gap between shelving and casework side panels to allow air movement inside casework.
  - 1. Up to 27 inches (686 mm) wide: Removable molded polyethylene shelf, with impact-resistant, radiused front edge, mounted to cabinet wall with self-locking clip.
  - 2. Over 27 inches (686 mm) wide: For large instrument casework: Removable formed polyethylene shelf, ribbed, with high-impact-resistant, radiused front edge, supported by steel tube frame.
  - 3. Corner cabinet revolving shelving: 0.053 inch (1.3 mm) min. thickness steel sheet bolted to revolving steel center post, with radiused hardboard deflector panel.

### **2.4 ACCESSORIES**

- A. Filler Panels and Closure Kits: 3/4 inch (19 mm) thick particleboard thermoset panels with no urea formaldehyde in Oyster color. Provide the following, cut to fit field conditions, where indicated:
  - 1. Wall filler between cabinet side and wall.
  - 2. Top filler between cabinet top and wall.
  - 3. Top of cabinet closure panel between cabinet and finished ceiling or soffits.
  - 4. Finished back panel for exposed cabinet backs.

### **2.5 HARDWARE**

- A. Butt Hinges: 2-3/4 inch (70 mm), 5-knuckle steel hinges made from 0.090 inch (2.29 mm) thick metal, ANSI/BHMA A156.9, Grade 1, with powder-coated finish, through-bolted to door and side panels and welded to grille door frames. Provide 2 hinges on compartment doors, and 4 hinges on full-height doors.

- B. Slide Latch: 0.105 inch (2.67 mm) min. thickness steel, with padlock eye, powder-coat finish, through-bolted to panel door and side panel and welded to grille door frames. Latches securely without padlock. Provide with clear plastic label holder for use with standard size labels; number system available for user to print. Padlocks furnished by Owner.
  - C. Panel Connectors: 1/4–20 by 1.77 inch (45 mm) panel connectors, with steel thread inserts, powder coated to match panels.
  - D. Cabinet Levelers: Leveling glides with 3/8 inch (9.5 mm) diameter threaded steel rod in steel corner brackets, minimum two each per cabinet side, accessible from within unit, and concealed in completed installation.
  - E. Fasteners: Manufacturer-recommended fasteners as required for casework substrate and project performance requirements, consisting of one or more of the following:
    - 1. Sheet Metal Screws: SAE J78, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
    - 2. Wood Screws: ASME B18.6.1.
    - 3. Expansion Anchors in Concrete and Concrete Masonry Units: Carbon-steel, zinc plated.
- 2.6 FINISHES
- A. Steel Sheet, Steel Wire, and Exposed Fasteners: Urethane-based electrostatic powder coating, color as indicated.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine casework installation areas for compliance with requirements for installation tolerances, location of blocking and other anchoring reinforcements, and other existing conditions affecting installation and performance of casework. Proceed with casework installation upon correction of unsatisfactory conditions.

#### **3.2 CASEWORK INSTALLATION**

- A. Install plumb, level, and true; using integral levelers. Install in accordance with manufacturer's recommendations and approved submittals.
- B. Install hardware uniformly and precisely. Set hinges snug and flat. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- C. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind and close with uniform reveals.

#### **3.3 CLEANING AND PROTECTING**

- A. Repair or replace defective work as directed by Architect upon inspection.
- B. Clean casework surfaces. Touch up, refinish, or replace damaged components in a manner acceptable to Architect.
- C. Turn over operation and maintenance instructions to Owner.

**END OF SECTION**

## SECTION 12 36 23.13

### PLASTIC-LAMINATE-CLAD COUNTERTOPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes plastic-laminate-clad countertops.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad countertops.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
  - 3. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Verification: As follows:
  - 1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches (200 by 250 mm) in size.
  - 2. Wood-Grain Plastic Laminates: For each type, color, pattern, and surface finish required, 12 by 24 inches (300 by 600 mm) in size.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For the following:
  - 1. Composite wood products.
  - 2. High-pressure decorative laminate.
  - 3. Adhesives.
- C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

##### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  - 1. Shop Certification: AWI's Quality Certification Program accredited participant.
- B. Installer Qualifications: Fabricator of products.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

##### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## **PART 2 - PRODUCTS**

### **2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS**

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
  - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
  - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Abet Laminati Inc.
    - b. Formica Corporation.
    - c. Lamin-Art, Inc.
    - d. Nevamar; a Panolam Industries International, Inc. brand.
    - e. Pionite; a Panolam Industries International, Inc. brand.
    - f. Wilsonart.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As scheduled.
- E. Edge Treatment: 3-mm (0.12 inch) PVC edging.
- F. Core Material: MDF made with exterior glue or Exterior-grade plywood.
- G. Core Material at Sinks: MDF made with exterior glue or exterior-grade plywood.
- H. Core Thickness: 3/4 inch (19 mm).
- I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

### **2.2 WOOD MATERIALS**

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
  - 1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
  - 2. Softwood Plywood: DOC PS 1.

### **2.3 ACCESSORIES**

- A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Doug Mockett & Company, Inc.: TG Flip-Top Series.
  - 2. Outside Diameter: 2 inches (51-mm).
  - 3. Color: As selected by Architect from Manufacturer's full range.



- B. Countertop Support Brackets: Steel, 18 inches by 24 inches, minimum 1,000 lb load limit, factory-applied primer for field painting in accordance with Section 09 91 23 "Interior Painting."
  - 1. Acceptable Products:
    - a. A & M Hardware; Work Station Brackets.
      - 1) Provide manufacturer's standard factory-applied primer. Refer to Section 09 91 23 "Interior Painting" for finish coat.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

#### 2.5 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to radius indicated for the following:
  - 1. Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of cutouts by saturating with varnish.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

#### 3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
  - 1. Where field cuts are unavoidable, provide cutouts as required. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
  - 1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
  - 2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
  - 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semiexposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

**END OF SECTION**

## SECTION 12 36 61.16

### SOLID SURFACING COUNTERTOPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Solid surface material countertops.
  - 2. Solid surface material backsplashes.
  - 3. Solid surface material end splashes.
  - 4. Solid surface material apron fronts.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
  - 1. Show locations and details of joints.
  - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
  - 1. Countertop material, 6 inches (150 mm) square.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

##### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
  - 1. Build mockup of typical countertop as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

##### 1.6 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

#### PART 2 - PRODUCTS

##### 2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Affinity Surfaces; a brand of Domain Industries, Inc.
    - b. Avonite Surfaces.
    - c. E. I. du Pont de Nemours and Company.
    - d. Transolid Div of Trumbull Industries.
    - e. Wilsonart.

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As scheduled.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- C. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Doug Mockett & Company, Inc.: TG Flip-Top Series.
  2. Outside Diameter: 2 inches (51-mm).
  3. Color: As selected by Architect from Manufacturer's full range.
- D. Countertop Support Brackets: Steel, 18 inches by 24 inches, minimum 1,000 lb load limit, factory-applied primer for field painting in accordance with Section 09 91 23 "Interior Painting."
  1. Acceptable Products:
    - a. A & M Hardware; Work Station Brackets.
      - 1) Provide manufacturer's standard factory-applied primer. Refer to Section 09 91 23 "Interior Painting" for finish coat.

## 2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
  1. Grade: Custom.
- B. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material.
- C. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material with wood-trimmed edges.
- D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
  1. Fabricate with loose backsplashes for field assembly.
  2. Install integral sink bowls in countertops in the shop.
- E. Joints: Fabricate countertops without joints.
- F. Cutouts and Holes:
  1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
    - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
  2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
  3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

## 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

**END OF SECTION**

## SECTION 123661.19

### QUARTZ AGGLOMERATE COUNTERTOPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Quartz agglomerate countertops.
  - 2. Quartz agglomerate backsplashes.
  - 3. Quartz agglomerate end splashes.
  - 4. Quartz agglomerate apron fronts.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
  - 1. Show locations and details of joints.
  - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
  - 1. Countertop material, 6 inches (150 mm) square.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

##### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
  - 1. Build mockup of typical countertop as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### 1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

##### 1.6 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

#### PART 2 - PRODUCTS

##### 2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Cambria.
    - b. Cosentino USA.
    - c. E. I. du Pont de Nemours and Company.
    - d. Transolid Div of Trumbull Industries.

- e. Wilsonart.
    - 2. Colors and Patterns: As scheduled.
  - B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
  - C. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
    - 1. Products: Subject to compliance with requirements, provide the following:
      - a. Doug Mockett & Company, Inc.: TG Flip-Top Series.
      - 2. Outside Diameter: 2 inches (51-mm).
      - 3. Color: As selected by Architect from Manufacturer's full range.
  - D. Countertop Support Brackets: Steel, 18 inches by 24 inches, minimum 1,000 lb load limit, factory-applied primer for field painting in accordance with Section 099123 "Interior Painting."
    - 1. Acceptable Products:
      - a. A & M Hardware; Work Station Brackets.
        - 1) Provide manufacturer's standard factory-applied primer. Refer to Section 099123 "Interior Painting" for finish coat.
- 2.2 COUNTERTOP FABRICATION
- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
    - 1. Grade: Custom.
  - B. Countertops: 1/2-inch- (12.7-mm-) thick, quartz agglomerate.
  - C. Backsplashes: 1/2-inch- (12.7-mm-) thick, quartz agglomerate.
  - D. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
    - 1. Fabricate with loose backsplashes for field assembly.
  - E. Joints: Fabricate countertops without joints.
  - F. Cutouts and Holes:
    - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
    - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
    - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
- 2.3 INSTALLATION MATERIALS
- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
  - B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

**END OF SECTION**



## SECTION 12 61 00

### UPHOLSTERED FIXED AUDIENCE SEATING

#### PART 1 - GENERAL

##### 1.1 WORK OF THIS SECTION

- A. This Section includes all labor, materials, equipment, and services necessary to manufacture, deliver to job site, and install the fixed seating as shown on the drawings and/or specified herein, including but not limited to, the following:
  - 1. Floor mounted fixed seating
  - 2. Riser mounted fixed seating
- B. Furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

##### 1.2 SUBSTITUTIONS

- A. Substitutions are allowed when the substitution improves the quality, decrease installation time, or reduce cost.
  - 1. Submit a proposal that clearly outlines construction features of the product so that true and accurate comparisons may be made.
    - a. Samples of the proposed substitution item/s may be requested by the Architect and/or Owner for evaluation.
- B. No product bid which deviates from the details of the Construction Documents will be considered unless such deviation has been approved in advance by the Architect.

##### 1.3 SUBMITTAL WITH BID

- A. The Fixed Seating Manufacturer shall submit a list of not less than five installations of similar scope and size, installed by the bidder, that have been in service for a minimum of one year and a maximum of five years.
- B. The Fixed Seating Manufacturer shall also submit for review by the Architect the following samples and certificates:
  - 1. One notarized certificate of compliance with ASTM A-48 Class 25 for all gray iron castings.
  - 2. One notarized certificate of compliance with California Bulletin #117.
- C. Furnish with bid a schedule of the following:
  - 1. Length of time required to prepare shop drawings.
  - 2. Length of time required to supply all equipment.
  - 3. Length of time required to install all equipment.
- D. Include in the bid full freight and insurance charges for all equipment to the job site.

##### 1.4 SUBMITTALS

- A. Prepare and submit documents for review in accordance with the requirements of the Contract Documents.
- B. Furnish all of the above for review by the Architect prior to commencing any work.
  - 1. Such review does not relieve the Manufacturer of the responsibility of providing equipment in accordance with this Specification.
- C. Shop drawings:
  - 1. 1/4-inch scale plans showing complete field dimensions including accurate measurements of actual row lengths, and measurements from edge of stage to back of each row.
  - 2. If field dimensions differ from Construction Drawings, shop drawing shall show proposed changes in seat width layout based on the accurate field measurements.
    - a. Proposed changes are subject to review by Architect.
  - 3. Provide seat anchorage details that clearly indicate the method used and the devices employed for attaching anchors to existing concrete or risers.
  - 4. If substituting fasteners, provide stamped calculations and details for submittal to DSA.

- D. All materials, finishes, coverings, and construction of fixed seat shall be detailed in the shop drawings including:
    - 1. Seat pans and foam bottoms
    - 2. Seat backs
    - 3. Aisle standards, including aisle lights
    - 4. ADA-compliant aisle standards
    - 5. Pedestal or riser mounts as shown on construction drawings
    - 6. Middle standards
    - 7. Armrests
    - 8. Seat and row numbers
    - 9. Removable seat mounting hardware
  - E. Any deviation from the contract documents shall be clouded and noted in letters a minimum 1/4-inch high.
    - 1. In order for a deviation to be considered, it must upgrade the quality of the equipment or respond to a field condition.
  - F. Before fabrication shall begin, the Fixed Seating Manufacturer shall submit for review a completely assembled sample chair with fabric, stain color, enamel finish, etc. meeting all requirements set forth in this Specification.
    - 1. Sample shall include:
      - a. One aisle standard with functioning aisle light and transformer
      - b. One aisle standard without aisle light
      - c. Two complete adjacent seats 21-inches wide
    - 2. Provide one separate of an ADA-compliant aisle standard
    - 3. Sample chairs shall be retained for quality comparison with actual installation
- 1.5 MANUFACTURER'S RESPONSIBILITY
- A. Study the contract drawings and specifications with regard to the work as shown and required under this section so as to insure its completeness. Pay particular attention to all architectural and structural drawings relevant to construction of the flooring and substructure of all floor areas which will receive seating units.
  - B. Verify, by field measurement on the job site, all dimensions affecting the work.
    - 1. Reproduce the reviewed seating plan on the floor prior to seating install. Check dimensions and layout against the conditions encountered in the field.
    - 2. Bring field dimensions which vary from those on the approved shop drawings to the attention of the Architect.
      - a. If required, obtain a directive from the Architect and Owner regarding corrective measures before the start of fabrication of items affected by the variance.
  - C. Examine all surfaces and conditions to which this work shall be attached or applied.
    - 1. Notify the Architect and Construction Manager, in advance of commencement of installation, if any conditions or surfaces exist which the Manufacturer considers detrimental to the proper and expeditious installation of its work.
    - 2. Starting of the installation shall imply acceptance of the surfaces and conditions to perform the work as specified.
  - D. Manufacturer shall cooperate in the coordination and scheduling of the delivery and installation of fixed seating with the General Contractor/Construction Manager and/or other trades so as not to delay job progress.
- 1.6 DELIVERY
- A. Delivery and installation per the Contract Documents.
  - B. Deliver the seating to the job site fully fabricated and ready for installation, in the Manufacturer's protective packaging.
    - 1. Spare parts shall be packaged separately and delivered to job site on the last day of installation.
  - C. Do not deliver any materials to the job site until the construction has reached a stage to accept the installation. Storing seating materials at the job site will not be permitted.
- 1.7 WARRANTY
- A. Manufacturer shall make all applicable repairs, including replacement of materials, at no cost to the Owner for a period of five years from the date of final acceptance.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. Manufacturers for work in this section:
1. Camatic Seating
  2. Farmers Branch, TX
  3. (682) 503-5317
  4. <https://camatic.com/>
  5. Ducharme Seating
  6. Montreal, Quebec
  7. (514)328-2772
  8. <https://www.ducharmeseating.com>
  9. Irwin Seating Co.
  10. Grand Rapids, MI
  11. (616) 574-7400
  12. <https://www.irwinseating.com/>
  13. SERIES Seating
  14. Miami, FL
  15. (305) 932-4626
  16. <https://seriesseating.com/>
  17. Wenger Corporation
  18. Owatonna, MN
  19. (800) 268-0148
  20. <https://www.wengercorp.com/>

### 2.2 BASIS OF DESIGN:

- A. Fixed Audience Seats: Wenger Cavea

### 2.3 GENERAL

- A. Floor or riser mount type with upholstered inner back panel and hardwood veneer outer back; upholstered seat cushions with hardwood veneer seat pan; hardwood armrests; aisle standards with LED aisle lights, middle standards; seat number plates and row letter plates as specified herein.
- B. When unoccupied, the seat bottom shall rise to a uniform, minimum 3/4-fold position without need of adjustment at any time.

### 2.4 QUANTITIES

- A. Provide and install quantity of chairs as shown on the drawings.
- B. The final determination of the total number of seats of each width cannot be made until the Manufacturer produces shop drawings for the project based upon accurate field measurements.
- C. Provide seat backs and seat bottoms in widths as shown on the drawings or as required based on field measurements.
- D. After installation is complete, provide the spare parts listed below in separate packing cartons, with labels listing the contents of each package:
1. Complete seat backs: Four of each size provided
  2. Complete seat bottoms: Four of each size provided
  3. Seat back upholstery covers: Six of each size provided
  4. Seat cushion upholstery covers: Six of each size provided
  5. Floor mounted aisle standards
    - a. Left, with aisle light: Two
    - b. Right, with aisle light: Two
    - c. Left, without aisle light: Two
    - d. Right, without aisle light: Two
  6. Riser mounted aisle standards
    - a. Left, with aisle light: Two
    - b. Right, with aisle light: Two
    - c. Left, without aisle light: Two
    - d. Right, without aisle light: Two
  7. Middle standards
    - a. Floor mounted: Two

- b. Riser mounted: Two
- 8. Wall standards
  - a. Right, floor mounted: Two
  - b. Left, floor mounted: Two
  - c. Right, riser mounted: Two
  - d. Left, riser mounted: Two
- 9. Armrests
  - a. with aisle light: Four
  - b. without light: Four
- 10. Fifty bolts used for mounting removable seats.
- 11. Twenty recessed female floor anchors of each type used for securing removable seats.
- 12. One quart or two spray cans of paint used on metal surfaces.
- 13. Provide an additional bolt of fabric of the same dye lot to the Owner as spare stock.
  - a. Label fabric to identify fabric manufacturer, weight, type number, color number and manufacture date.

## 2.5 MATERIALS

- A. Hardwood: TBD
- B. Plywood:
  - 1. well-seasoned hardwoods, free of bark pockets, cross breaks, knot holes, open splits, open joints, etc.
    - a. Finished veneer species: TBD
    - b. Inner plys shall be minimum Class 2 hardwood veneer. Class 3 (utility grade) or Class 4 (backing grade) veneers will not be accepted for inner plys.
  - 2. Glue used to join all plywood and composite wood components shall have no added urea-formaldehyde and shall meet the following:
    - a. ASTM Designation D-805-63.
    - b. Twenty Dry shear test pulls, not less than 300 lbs. per square inch.
    - c. Ten Wet shear test pulls after 48 hours of immersion, not less than 200 lbs. per square inch
- C. Gray Iron: quality and strength in accordance with ASTM Designation A48-64 for Class 25 gray iron casting.
- D. Steel: smooth surfaces and sufficient gauge thickness to withstand strains of daily use.
- E. Finish
  - 1. Match stain finish to control sample indicated in the finish schedule.
    - a. Coat all exposed surfaces with lacquer of sufficient film depth to afford adequate protection in use
  - 2. Clean metal parts with hot alkyd spray and hot water rinse
    - a. Treat iron phosphate before finishing
    - b. Finish with a powdered epoxy paint that meets or exceeds the following:
      - 1) Dry Film Thickness: Average coating of 2 mils as per ASTM-D-1400-81.
      - 2) Hardness (Pencil): Assure an H pencil hardness as per ASTM-D-3363-74.
      - 3) Abrasion: Taber/Abraser Test to assure a maximum of 60 mg weight loss to the tested part after 1,000 cycles with a CS-10 wheel weighing 1,000 grams.
  - 3. Painted parts shall be gas oven baked at a minimum of 350 degrees Fahrenheit for twenty minutes to assure an even, smooth and fully cured finish. (detail paint excepted)
  - 4. Paint color as scheduled
- F. Foam Padding for seat backs: cold cure polyurethane foam.
  - 1. Padding material shall comply with the flammability requirements outlined in California Technical Information Bulletin #117.

## 2.6 CONSTRUCTION DETAILS

- A. Aisle Standards:
  - 1. Construction:
    - a. Materials TBD
    - b. Proper thickness and design required to properly support the adjacent seat at the correct height and pitch
  - 2. Mounting: floor
    - a. Proper thickness and design required to properly support the adjacent seat at the correct height and pitch

- b. The steel or cast foot shall allow for severe tightening and shock without fracture
  3. Aisle Panel: TBD
    - a. Thickness: TBD
  4. Finish:
    - a. TBD
  5. Weld a bracket for seat attachment or cast to the inside of the standard.
    - a. Gas-shielded or arc welds
  6. Provide dovetails for attachment of aisle standard armrests
  7. Provide aisle standards comparable to above with ADA-compliant swing out panel in locations shown on the drawings.
    - a. Each ADA aisle standard shall be provided with a label, displaying an easily recognizable "handicapped" symbol.
    - b. Recess for ADA plate at aisle side of panel
    - c. Provide aisle light at ADA-compliant aisle standard(s) as required. Refer electrical drawings for aisle light locations
- B. Middle and Wall Standards:
  1. Construction: TBD
    - a. One-piece dovetail or welded bracket at the top of the attachment
  2. Mounting: floor
    - a. level
  3. Middle and wall standards shall be cast iron or steel with a one-piece dovetail or bracket welded to the top of the attachment of the armrest.
  4. Cast or welded wing plate to the standard to provide for attachment of the back.
    - a. Brackets: cast or of minimum 11-gauge steel welded on the side of the standard.
- C. Seat Backs:
  1. Construction: padded, upholstered front panel and a rear panel of exposed hardwood veneer plywood enclosing a 3/8-inch diameter welt of specified fabric
  2. No visible fasteners
  3. The back wings for the attachment of the complete back to the standard shall be secured at the rear of the upholstered face panel sandwiched between the two panels.
    - a. Method of attachment of the back wings to the plywood panel shall be with "T" nuts, or equivalent, properly embedded within the panel.
    - b. The back wings shall be uniform through the auditorium so that the spaces between backs are consistent.
    - c. Back pitch:
      - 1) 20 degrees
  4. The backs shall be in same widths as seat bottoms so that the spaces between adjacent backs are consistent throughout the seating area.
    - a. Provide seat backs in widths as shown on the drawings or as required based on field measurements.
- D. Wood Seat Pan:
  1. Construction: padded, upholstered seat and pan of exposed hardwood veneer plywood
  2. No visible fasteners
- E. Aisle Lights:
  1. Low voltage "warm white" LED aisle light fixture
  2. Location: recessed in the armrest, concealed from view
    - a. A sufficient opening shall be designed into the armrest allowing the tread and/or step to be illuminated
  3. Properly ground the light and pre-wired into the standard with conductors enclosed in flex-steel conduit extending a minimum of 18 inches beyond the foot of the standard.
    - a. The wiring shall be provided with a 90-degree angle connector.
  4. Manufacturer shall provide adequately sized transformer(s) housed in a steel enclosure and equipped with primary and secondary fuses or circuit breakers, terminal blocks and safety disconnect
  5. Provide instructions and details as necessary for termination by Electrical Contractor.
    - a. Confirm that the distribution meets minimum performance egress requirements.
- F. Armrest:
  1. Construction: Solid maple with edges well rounded
  2. Two slots in the bottom and shall lock securely to the lugs on the aisle and middle standards

- G. Seat Number Plates:
  - 1. Location TBD
    - a. Attach with two rivets or pins
  - 2. Provide samples for selection by architect from Manufacturer's standard options
- H. Row Letter Plates:
  - 1. Recessed in the armrest
    - a. Attach with two rivets or pins
  - 2. Provide samples for selection by architect from Manufacturer's standard options
- I. Donor Plates:
  - 1. Recessed in the armrest
    - a. Attach with two rivets or pins
  - 2. Provide samples for selection by architect from Manufacturer's standard options

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Installation shall be supervised by the Manufacturers own experienced superintendent in strict conformance with the approved seating layout shop drawings.
  - 1. The same individual shall remain in charge of the work throughout the installation.
  - 2. The superintendent shall represent the Manufacturer in his/her absence and all directions given to the superintendent shall be binding as if given to the Manufacturer.
- B. Storage of tools, equipment, etc. during the period of the installation falls on the responsibility of the Manufacturer

#### **3.2 INSTALLATION**

- A. All standards anchored to concrete using two new bolts per standard.
- B. For removable seats, provide and install flush mounted tapped steel anchors in the floor to ensure easy mounting.
  - 1. For wood floors, provide "T-nut" type tapped steel floor inserts.
    - a. "T-nut" flanged shall be screwed to the underside of the platform top.
    - b. Flush mount inserts that attach to the top surface of the removable platform shall not be permitted.
  - 2. For concrete floors, provide epoxy anchors.
- C. Use properly sized fasteners. Breaking off oversized bolts on seat pan and seat back connections not allowed.
  - 1. Use "acorn" or cap nuts on bolts connecting back wings to standards.
- D. Provide aisle lights in designated locations.
- E. Install all seating accurately and securely in designated locations
  - 1. Ensure seating is rigid, plumb, accurately aligned and neatly executed
- F. All movable parts shall operate smoothly and quietly, and all backs and seats, when not occupied, shall be upright and at the same angle respectively.
- G. Compliance testing to include the following:
  - 1. Seat is functioning for use intended
  - 2. Number and letter plates are securely fastened in place
  - 3. Seat and row identification plates are correct
  - 4. Applied finishes are free from scratches or abrasions

#### **3.3 MANUALS**

- A. Provide the Owner with one printed "hard" copy Operations and Maintenance manual as well as the O&M manual in electronic format on two flash drives. Operations and Maintenance Manuals include, but not be limited to the following:
  - 1. Contact name, phone number and e-mail address
  - 2. Record shop drawings
  - 3. Catalogue cuts and complete parts list of equipment installed
  - 4. Recommended maintenance procedures

5. Information identifying fabric manufacturer, type number, color number, weight, width and manufacture date

3.4 PROTECTION AND CLEANING

- A. Protect installed seating by carefully covering the seats with 4 MIL plastic sheets secured at corners to prevent damage to the installed work.
  1. Repair or replace all damaged seats as directed by the Owner and/or Architect at no additional cost to the Owner.
- B. Provide barriers as required to protect the surfaces or equipment provided by other contractors from damage during the seat installation.
- C. Clean all seats, surfaces, and materials of debris, dirt, and foreign materials at the completion of installation.
- D. Remove packaging materials from job site including barriers provided for protection of other contractor's materials and equipment.

END OF SECTION 12 61 00

## SECTION 142123.16

### MACHINE-ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes machine-room-less electric traction passenger elevators.

##### 1.2 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
  - 2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Include large-scale layout of car-control station and standby power operation control panel.
  - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3 inch- (75 mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- C. Sample Warranty: For special warranty.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
  - 1. Submit manufacturer's or Installer's standard operation and maintenance manual, according to ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

##### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.



1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: Four year(s) from date Buyer accepts products.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. KONE Inc.
  - 2. Otis Elevator Co.
  - 3. Schindler Elevator Corp.
  - 4. ThyssenKrupp Elevator.
- B. Source Limitations: Obtain elevators from single manufacturer.
  - 1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
  - 1. Basis-of-Design Product: ThyssenKrupp Elevator; Endura MRL, 2 Stage.
  - 2. Rated Load: 3500 lb (1589 kg).
  - 3. Freight Loading Class for Service Elevator(s): Class A.
  - 4. Rated Speed: 150 fpm (0.75 m/s).
  - 5. Operation System: Selective-collective automatic operation.
  - 6. Auxiliary Operations:
    - a. Standby power operation.
    - b. Standby-powered lowering.
    - c. Battery-powered automatic evacuation.
    - d. Automatic dispatching of loaded car.
    - e. Nuisance-call cancel.

- f. Automatic operation of lights and ventilation fans.
- g. Independent service for service elevator.
- 7. Security Features: Card-reader operation .
- 8. Dual Car-Control Stations: Provide two car-control stations; equip only one with required keyswitches if any.
- 9. Car Enclosures:
  - a. Inside Height: Not less than 93 inches (2362 mm) to underside of ceiling.
  - b. Front Walls (Return Panels): Satin stainless steel, No. 4 finish.
  - c. Car Fixtures: Satin stainless steel, No. 4 finish.
  - d. Side and Rear Wall Panels: Plastic laminate.
  - e. Reveals and Base: Enameled or powder-coated steel.
  - f. Door Faces (Interior): Satin stainless steel, No. 4 finish.
  - g. Door Sills: Aluminum.
  - h. Ceiling: Satin stainless steel, No. 4 finish.
  - i. Handrails: 2 inches round satin stainless steel, No. 4 finish, at sides and rear of car.
  - j. Floor prepared to receive flooring as selected by Architect.
  - k. Floor Thickness, Including Setting Materials: As recommended by manufacturer, above plywood subfloor.
- 10. Hoistway Entrances:
  - a. Width: 36 inches (914 mm), unless otherwise indicated.
  - b. Height: 84 inches (2134 mm), unless otherwise indicated.
  - c. Type: Single-speed center opening.
  - d. Frames: Satin stainless steel, No. 4 finish.
  - e. Doors: Satin stainless steel, No. 4 finish.
  - f. Sills: Aluminum.
- 11. Hall Fixtures: Satin stainless steel, No. 4 finish.
- 12. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
  - b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

## 2.4 TRACTION SYSTEMS

- A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
  - 1. Provide regenerative system.
  - 2. Provide regenerative system that complies with the IgCC.
  - 3. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
  - 4. Provide means for absorbing regenerated power when elevator system is operating on standby power.
  - 5. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. Fluid for Hydraulic Buffers: Fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Bolted- or welded-steel units.
- F. Guides: Roller guides. Provide guides at top and bottom of car and counterweight frames.

## 2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

- B. Auxiliary Operations:
1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
  2. Single-Car Battery-Powered Automatic Evacuation: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it moves to the next floor above or below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
  3. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
  4. Nuisance-Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
  5. Off-Peak Operation: During periods of low traffic, half of the elevators in a group shall be taken out of service and switched to sleep, low power mode.
  6. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after five minutes and are re-energized before car doors open.
- C. Security features shall not affect emergency firefighters' service.
1. Card-Reader Operation: System uses card readers at car-control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space for card reader in car.
    - a. Security access system equipment is indicated in Electrical Engineer's documents.

## 2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

## 2.7 CAR ENCLOSURES

- A. General: Provide enameled or powder-coated steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
  2. Subfloor: Exterior, C-C Plugged grade plywood, not less than 7/8-inch (22.2-mm) nominal thickness.
  3. Floor Finish: As selected by Architect.
  4. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2 inch (13 mm) fire-retardant-treated particleboard with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels shall have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
  5. Fabricate car with recesses and cutouts for signal equipment.
  6. Fabricate car door frame integrally with front wall of car.
  7. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
  8. Sight Guards: Provide sight guards on car doors.
  9. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
  10. Metal Ceiling: Flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.

11. Light Fixture Efficiency: Not less than 35 lumens/W.
12. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

## 2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
  1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
  1. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
  1. Enameled or Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by Architect from manufacturer's full range.
  2. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel or powder-coat finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
  3. Stainless-Steel Frames: Formed from stainless-steel sheet.
  4. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both jambs of hoistway door frames.
  5. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
  6. Sight Guards: Provide sight guards on doors matching door edges.
  7. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
  8. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

## 2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
  1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
  2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
  1. Mark buttons and switches for function. Use both tactile symbols and Braille.
  2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Electrical Engineer's documents.
- F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- G. Hall Push-Button Stations: Provide one hall push-button station at each landing.
  1. Provide manufacturer's standard wall-mounted units.
  2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
    - a. Provide for connecting units to building security access system so a card reader can be used to register calls.

3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Electrical Engineer's documents.
  - H. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
    1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
  - I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
    1. At manufacturer's option, audible signals may be placed on cars.
  - J. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate and with body of unit recessed in wall.
    1. Integrate ground-floor hall lanterns with hall position indicators.
  - K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
  - L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.
- 2.10 FINISH MATERIALS
- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
  - B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
  - C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
  - D. Stainless-Steel Bars: ASTM A 276, Type 304.
  - E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
  - F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
  - G. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

- F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
  - 1. Place hall lanterns either above or beside each hoistway entrance.
  - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:
  - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  - 2. Provide strippable protective film on entrance and car doors and frames.
  - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
  - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  - 5. Do not load elevators beyond their rated weight capacity.
  - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
- B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

### 3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance during normal working hours.
  - 2. Perform emergency callback service during normal working hours with response time of two hours or less.
  - 3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

**END OF SECTION**

## SECTION 21 05 00

### COMMON WORK RESULTS FOR FIRE SUPPRESSION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. The Work of this Section includes:
  1. Sleeves without waterstop.
  2. Sleeves with waterstop.
  3. Stack-sleeve fittings.
  4. Sleeve-seal systems.
  5. Grout.
  6. Silicone sealants.
  7. Escutcheons.

##### 1.2 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  1. For each type of product, excluding motors which are included in Part 1 of the fire-suppression equipment Sections.
    - a. Include construction details, material descriptions, and dimensions of components.
    - b. Include operating characteristics and furnished accessories.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
  1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
  2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
  3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
  4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
  5. Molded-PVC Sleeves: With nailing flange.
  6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Sleeves with Waterstop:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, LLC.
    - b. GPT; a division of EnPRO Industries.
    - c. Metraflex Company (The).
    - d.
  2. Description: Manufactured galvanized steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Stack-Sleeve Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Wade; a subsidiary of McWane Inc.

- c. Zurn Industries, LLC.
    2. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
      - a. Underdeck Clamp: Clamping ring with setscrews.
  - D. Sleeve-Seal Systems:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Advance Products & Systems, LLC.
      - b. GPT; a division of EnPRO Industries.
      - c. Metraflex Company (The).
    2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
      - a. Hydrostatic Seal: 20 psig minimum.
      - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
      - c. Pressure Plates: Stainless steel.
      - d. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.
  - E. Grout:
    1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
    2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
    3. Design Mix: 5000 psi, 28-day compressive strength.
    4. Packaging: Premixed and factory packaged.
  - F. Silicone Sealants:
    1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
      - a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
    2. Silicone Sealant, S, P, T, NT: Single-component, 100/50, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
      - a. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.
- 2.2 ESCUTCHEONS
- A. Escutcheon Types:
    1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
    2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
    3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
    4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
    5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS**

- A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

#### **3.2 INSTALLATION OF SLEEVES, GENERAL**

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.



3. Using silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire-resistance of floor/slab/wall.
  - D. Install sleeves for pipes passing through interior partitions.
    1. Cut sleeves to length for mounting flush with both surfaces.
    2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
    3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
  - E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."
- 3.3 INSTALLATION OF SLEEVES WITH WATERSTOP
- A. Install sleeve with waterstop as new walls and slabs are constructed.
  - B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width centered in concrete slab or wall.
  - C. Secure nailing flanges to wooden concrete forms.
  - D. Using silicone sealant, seal space around outside of sleeves.
- 3.4 INSTALLATION OF STACK-SLEEVE FITTINGS
- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
    1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
    2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
    3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
    4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
    5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
  - B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- or smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."
- 3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS
- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
  - B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.
- 3.6 INSTALLATION OF ESCUTCHEONS
- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
  - B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 3.7 FIELD QUALITY CONTROL
- A. Sleeves and Sleeve Seals:
    1. Perform the following tests and inspections:
      - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
      - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
    2. Prepare test and inspection reports.

- B. Escutcheons:
  - 1. Using new materials, replace broken and damaged escutcheons and floor plates.

### 3.8 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above and below Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 2. Concrete Slabs-on-Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs above Grade:
    - a. stack-sleeve fittings.
  - 4. Interior Walls and Partitions:
    - a. Sleeves without waterstops.

### 3.9 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
  - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  - 2. Chrome-Plated Piping: One piece, cast brass with polished, chrome-plated finish.
  - 3. Insulated Piping:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 6. Bare Piping in Unfinished Service Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  - 7. Bare Piping in Equipment Rooms:
    - a. One piece, cast brass with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
  - 1. Chrome-Plated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  - 2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  - 5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  - 6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping and Relocated Existing Piping: One piece, floor plate.
  - 2. Existing Piping: Split floor plate.

END OF SECTION 21 05 00

## SECTION 21 05 23

### GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Two-piece ball valves with indicators.
  - 2. Bronze butterfly valves with indicators.
  - 3. Iron butterfly valves with indicators.
  - 4. Check valves.
  - 5. Bronze OS&Y gate valves.
  - 6. Iron OS&Y gate valves.
  - 7. NRS gate valves.
  - 8. Indicator posts.
  - 9. Trim and drain valves.

##### 1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, and weld ends.
  - 3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

#### PART 2 - PRODUCTS

##### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

##### 2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
  - 1. Fire Main Equipment: HAMV - Main Level.
    - a. Indicator Posts, Gate Valve: HCBZ - Level 1.
    - b. Ball Valves, System Control: HLUG - Level 3.
    - c. Butterfly Valves: HLXS - Level 3.
    - d. Check Valves: HMER - Level 3.
    - e. Gate Valves: HMRZ - Level 3.

2. Sprinkler System and Water Spray System Devices: VDG T - Main Level.
    - a. Valves, Trim and Drain: VQGU - Level 1.
  - B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
    1. Automated Sprinkler Systems:
      - a. Indicator posts.
      - b. Valves.
        - 1) Gate valves.
        - 2) Check valves.
        - 3) Miscellaneous valves.
  - C. ASME Compliance:
    1. ASME B1.20.1 for threads for threaded-end valves.
    2. ASME B16.1 for flanges on iron valves.
    3. ASME B31.9 for building services piping valves.
  - D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
  - E. NFPA Compliance for Valves:
    1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
  - F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
  - G. Valve Sizes: Same as upstream piping unless otherwise indicated.
  - H. Valve Actuator Types:
    1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
    2. Handwheel: For other than quarter-turn trim and drain valves.
    3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.
- 2.3 TWO-PIECE BALL VALVES WITH INDICATORS
- A. Description:
    1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
    2. Minimum Pressure Rating: 175 psig.
    3. Body Design: Two piece.
    4. Body Material: Forged brass or bronze.
    5. Port Size: Full or standard.
    6. Seats: PTFE.
    7. Stem: Bronze or stainless steel.
    8. Ball: Chrome-plated brass.
    9. Actuator: Worm gear
    10. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
    11. End Connections for Valves NPS 2-1/2: Grooved ends.
- 2.4 BRONZE BUTTERFLY VALVES WITH INDICATORS
- A. Description:
    1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
    2. Minimum: Pressure rating: 175 psig.
    3. Body Material: Bronze.
    4. Seat Material: EPDM.
    5. Stem Material: Bronze or stainless steel.
    6. Disc: Stainless steel with EPDM coating.
    7. Actuator: Worm gear.
    8. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
    9. Ends Connections for Valves NPS 2-1/2: Grooved ends.
- 2.5 IRON BUTTERFLY VALVES WITH INDICATORS
- A. Description:
    1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
    2. Minimum Pressure Rating: 175 psig.
    3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.

4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

## 2.6 CHECK VALVES

### A. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

## 2.7 BRONZE OS&Y GATE VALVES

### A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

## 2.8 IRON OS&Y GATE VALVES

### A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged.

## 2.9 NRS GATE VALVES

### A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.

## 2.10 INDICATOR POSTS

### A. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.

2. Type: Underground, Pit, Upright.
3. Base Barrel Material: .
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.
6. Operation: Wrench.

## 2.11 TRIM AND DRAIN VALVES

### A. Ball Valves:

1. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Design: Two piece.
  - c. Body Material: Forged brass or bronze.
  - d. Port size: Full or standard.
  - e. Seats: PTFE.
  - f. Stem: Bronze or stainless steel.
  - g. Ball: Chrome-plated brass.
  - h. Actuator: Handlever.
  - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
  - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

### B. Angle Valves:

1. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Material: Brass or bronze.
  - c. Ends: Threaded.
  - d. Stem: Bronze.
  - e. Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron, bronze, or aluminum.

### C. Globe Valves:

1. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Material: Bronze with integral seat and screw-in bonnet.
  - c. Ends: Threaded.
  - d. Stem: Bronze.
  - e. Disc Holder and Nut: Bronze.
  - f. Disc Seat: Nitrile.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, bronze, or aluminum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
  - 1. Section 21 10 00 "Water-Based Fire-Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install double-check valve assembly in each fire-protection water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 21 05 53 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 21 05 23

## SECTION 21 05 29

### HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe hangers and supports for fire-suppression piping - metal.
  - 2. Pipe hangers for fire-suppression piping - metal, trapeze type.
  - 3. Thermal Hanger Shield Inserts
  - 4. Fastener systems.
  - 5. Equipment supports.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Equipment supports.
- C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

##### 1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.



2.2 PIPE HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING - METAL

- A. Pipe Hangers and Supports for Fire-Suppression Piping - Carbon Steel:
  - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM Global approved for fire-suppression piping support.
  - 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 PIPE HANGERS FOR FIRE-SUPPRESSION PIPING - METAL, TRAPEZE TYPE

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM Global-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FASTENER SYSTEMS

- A. Fastener System - NFPA/UL/FM Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM Global-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Fastener System - NFPA/UL/FM Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM Global-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc coated or Stainless.
  - 2. Outdoor Applications: Stainless steel.

2.5 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM Global-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.6 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000 psi, 28-day compressive strength.

**PART 3 - EXECUTION**

3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to comply with NFPA 13 requirements, minimum 5 times the water-filled weight of piping and supported components plus 250 lb.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.

- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
  - E. Pipe Slopes: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
  - F. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
  - G. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
    - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
    - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
  - H. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
  - I. Fastener System Installation:
    - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners in accordance with powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
    - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions. Install in accordance with approvals and listings.
  - J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
  - K. Equipment Support Installation:
    - 1. Fabricate from welded-structural-steel shapes.
    - 2. Grouting: Place grout under supports for floor-mounted equipment and make bearing surface smooth.
    - 3. Provide lateral bracing, to prevent swaying.
- 3.3 INSTALLATION OF EQUIPMENT SUPPORTS
- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
  - B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
  - C. Provide lateral bracing, to prevent swaying, for equipment supports.
- 3.4 METAL FABRICATIONS
- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
  - B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
  - C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
    - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    - 2. Obtain fusion without undercut or overlap.
    - 3. Remove welding flux immediately.
    - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
- 3.5 ADJUSTING
- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
  - B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- 3.6 PAINTING
- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
  - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Comply with NFPA requirements.
- L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. C-Clamps (MSS Type 23): For structural shapes.
  - 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- M. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  - 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 21 05 29

## SECTION 21 05 53

### IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Warning tape
  - 4. Pipe labels.
  - 5. Valve tags.
  - 6. Warning tags.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032 inch thick, with predrilled or stamped holes for attachment hardware.
  - 2. Letter and Background Color: As indicated for specific application under Part 3.
  - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 5. Fasteners: Stainless steel rivets or self-tapping screws.
  - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

##### 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

### 2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch.
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F.
- F. Minimum Width: 2 inches.

### 2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

### 2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.04 inch thick, with predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire or S-hook.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Include valve-tag schedule in operation and maintenance data.

### 2.6 WARNING TAGS

- A. Description: Preprinted accident-prevention tags, of plasticized card stock.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Letter and Background Color: As indicated for specific application under Part 3.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of fire-suppression equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Fire-Suppression Pipe Label Color Schedule:
  - 1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where required.

END OF SECTION 21 05 53

## SECTION 21 10 00

### WATER-BASED FIRE-SUPPRESSION SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fire-suppression piping, fittings, and appurtenances.
  - 2. Fire department connections.
  - 3. Hose connections and hose stations.
  - 4. System control valves.
  - 5. Fire-suppression piping specialties.
  - 6. Cover systems for sprinkler piping.
  - 7. Sprinklers.
  - 8. Alarm devices.
  - 9. Manual control stations.
  - 10. Control panels.
  - 11. Pressure gauges.

##### 1.2 DEFINITIONS

- A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product.
    - a. Include construction details, material descriptions, dimensions of individual components and profiles.
    - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Prepare in accordance with NFPA 13 section "Working Plans."
    - a. Include plans, elevations, and sections of the system piping and details.
    - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
    - c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Prepare computer-generated hydraulic calculations in accordance with the following:
    - a. Minimum operating pressure at hydraulically most remote fire hose valve is to be 65 psig.
    - b. Water supply information, including fire hydrant flow test data report.
  - 3. Submit documents and calculations prepared by NICET Level III-certified technician, "Water-Based Systems Layout."
  - 4. Include diagrams for power, signal, and control wiring.
  - 5. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data prepared by NICET Level III-certified technician, "Water-Based Systems Layout."

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Qualification Data: For qualified Installer and NICET-certified technician.
- C. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.



- D. Welding certificates.
  - E. Field Test Reports:
    - 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
    - 2. Fire-hydrant flow test report.
  - F. Field quality-control reports.
- 1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
    - 2. System control valves.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications:
    - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by NICET Level III-certified technician, "Water-Based Systems Layout."
  - B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.
- 1.8 FIELD CONDITIONS
- A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression service in accordance with requirements indicated:
    - 1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire-suppression service.
    - 2. Do not proceed with interruption of fire-suppression service without Owner's written permission.

## **PART 2 - PRODUCTS**

- 2.1 SYSTEM DESCRIPTION
- A. Automatic wet-type, Class III standpipe system.
  - B. Automatic wet-pipe sprinkler system.
  - C. Automatic deluge sprinkler system.
- 2.2 PERFORMANCE REQUIREMENTS
- A. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
  - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - C. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13 and ASME A17.1.
  - D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.

- E. Delegated Design: Engage a NICET Level III-certified technician, "Water-Based Systems Layout" to design fire-suppression systems.
1. Fire-Hydrant Flow Test:
    - a. Available fire-hydrant flow test records indicate the following conditions:
      - 1) Date: 12/13/2022.
      - 2) Time: 8:30 a.m.
      - 3) Performed by: Charles Nelson of Service Fire.
      - 4) Location of Residual Fire Hydrant R: Back of school on the curb north of Accessible Parking spaces.
      - 5) Location of Flow Fire Hydrant F: Supply hydrant on North Access Road around the school.
      - 6) Static Pressure at Residual Fire Hydrant R: 76 psig.
      - 7) Measured Flow at Flow Fire Hydrant F: 1130 gpm.
      - 8) Residual Pressure at Residual Fire Hydrant R: 58 psig.
    - b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations.
  2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  3. Sprinkler Occupancy Hazard Classifications:
    - a. Educational: Light Hazard.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. Elevator Machine Room and Hoistway: Ordinary Hazard, Group 1.
    - d. Exterior Loading Docks, Only Handling Ordinary Combustibles: Ordinary Hazard, Group 2.
    - e. General Storage Areas: Ordinary Hazard, Group 1.
    - f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - g. Offices, including Data Processing: Light Hazard.
    - h. Stages: Ordinary Hazard, Group 2.
    - i. Theaters and Auditoriums, excluding Stages and Prosceniums: Light Hazard.
  4. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft. area.
  5. Minimum Density for Deluge-Sprinkler Piping Design:
    - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over entire area.
    - b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over entire area.
  6. Maximum protection area per sprinkler in accordance with UL listing.
  7. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 120 sq. ft.
    - b. Storage Areas: 130 sq. ft.
    - c. Mechanical Equipment Rooms: 130 sq. ft.
    - d. Electrical Equipment Rooms: 130 sq. ft.
    - e. Other Areas: In accordance with NFPA 13 recommendations unless otherwise indicated.
  8. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
  9. Minimum residual pressure at each hose-connection outlet is as follows:
    - a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig.
- F. Obtain documented approval of fire-suppression system design from AHJs.

### 2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

- A. Steel Pipe, Fittings, and Appurtenances:
1. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
    - a. Standards:
      - 1) UL 852.
      - 2) FM 1630.
    - b. Factory-applied exterior coating.
    - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
    - d. Pipe ends may be factory or field formed to match joining method.

2. Schedule 10 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
    - a. Standards:
      - 1) UL 852.
      - 2) FM 1630.
    - b. Factory-applied exterior coating.
    - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
    - d. Pipe ends may be factory or field formed to match joining method.
  3. Steel Pipe Nipples: black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
  4. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.
  5. Gray-Iron Threaded Fittings: Galvanized and uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
  6. Malleable- or Ductile-Iron Unions: ASME B16.3.
  7. Cast-Iron Flanges: ASME B16.1, Class 125.
  8. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
    - a. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
      - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
      - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
    - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.
  9. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
    - a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
  10. Plain-End-Pipe Fittings:
    - a. Pressure Rating: 175 psig minimum.
    - b. Plain-End Fittings for Steel Piping: Galvanized plain-end fittings, ASTM A53/A53M, carbon steel or ASTM A106/A106M, forged steel with dimensions matching steel pipe.
    - c. Plain-End-Pipe Couplings for Steel Piping: Rigid pattern for steel-pipe dimensions, ductile-iron or malleable-iron housing. Include EPDM-rubber gasket, and bolts and nuts.
  11. Grooved-Joint, Steel-Pipe Appurtenances:
    - a. Pressure Rating: 175 psig minimum.
    - b. Grooved-End Fittings for Steel Piping: Galvanized grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
    - c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
  12. Carbon Steel Pressure-Seal Fittings: UL 213, FM Approvals-approved, 175 psig pressure rating with carbon steel-, zinc-nickel-coated housing, EDPM O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
- B. Stainless Steel Pipe, Fittings, and Appurtenances:
1. Stainless Steel Pipe: ASTM A312/A312M, Type 316/316L, Schedule 10S, dimensions conforming to ASME B36.19M.
  2. Stainless Steel Pipe Fittings: ASTM A403/A403M.
  3. Fittings for Grooved-End, Stainless Steel Pipe:
    - a. Source Limitations: Obtain appurtenance for grooved-end, stainless steel pipe from single manufacturer.
    - b. Fittings for Grooved-End, Stainless Steel Pipe: Stainless steel casting with dimensions matching stainless steel pipe.
  4. Mechanical Couplings for Grooved-End, Stainless Steel Pipe:
    - a. AWWA C606 for stainless steel pipe dimensions.
    - b. Stainless steel housing sections.
    - c. Stainless steel bolts and nuts.
    - d. EPDM-rubber gaskets suitable for hot and cold water.
    - e. Minimum Pressure Rating:
      - 1) NPS 8 (DN 200) and Smaller: 600 psig.
      - 2) NPS 10 and NPS 12 (DN 250 to DN 300): 400 psig.
      - 3) NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig.

5. Stainless Steel Piping, Pressure-Seal-Joint Fittings:
    - a. Source Limitations: Obtain pressure-seal-joint fittings from single manufacturer.
    - b. Material: Type 316 stainless steel, ASTM A312/A312M.
    - c. Fittings: Type 316 stainless steel with EPDM O-ring seal in each end, and FM approved for fire protection applications.
  - C. Copper Tube, Fittings, and Appurtenances:
    1. Copper Tube, Drawn Temper: ASTM B88, Type K.
    2. Solder-Joint Fittings, Cast Copper: ASME B16.18 pressure fittings.
    3. Solder-Joint Fittings, Wrought Copper: ASME B16.22 pressure fittings.
    4. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
    5. Unions, Cast Copper: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
    6. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
    7. Copper Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
      - a. Description: Tee formed in copper tube in accordance with ASTM F2014.
    8. Grooved, Mechanical-Joint, Copper-Tube Appurtenances:
      - a. Standard: UL 213.
      - b. Grooved-End Copper Fittings: ASTM B75/B75M copper tube or ASTM B584 bronze castings.
      - c. Grooved-End-Tube Couplings: To fit copper tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting EPDM-rubber gasket rated for minimum 180 deg F for use with ferrous housing and steel bolts and nuts; 300 psig minimum CWP pressure rating.
    9. Copper-Tube, Pressure-Seal-Joint Fittings:
      - a. Fittings: Cast brass, cast bronze, or wrought copper with EPDM O-ring seal in each end.
      - b. Minimum 200 psig working-pressure rating at 250 deg F.
  - D. CPVC Pipe, Fittings, and Appurtenances:
    1. CPVC Pipe: ASTM F442/F442M and UL 1821, SDR 13.5, for 175 psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
    2. CPVC Fittings: UL listed or FM Approvals approved, for 175 psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
      - a. NPS 3/4 to NPS 1-1/2 (DN 20 to DN 40): ASTM F438 and UL 1821, Schedule 40, socket type.
      - b. NPS 2 to NPS 3 (DN 50 to DN 80): ASTM F439 and UL 1821, Schedule 80, socket type.
      - c. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
      - d. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
      - e. Flanges: CPVC, one or two pieces.
    3. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493 solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
    4. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- 2.4 FIRE DEPARTMENT CONNECTIONS
- A. Fire Department Connection, Exposed Type:
    1. Standard: UL 405.
    2. Description: Exposed, projecting, for wall mounting.
    3. Pressure Rating: 175 psig minimum.
    4. Body Material: Corrosion-resistant metal.
    5. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
    6. Caps: Brass, lugged type, with gasket and chain.
    7. Escutcheon Plate: Round, brass, wall type.
    8. Outlet: Back, with pipe threads.
    9. Number of Inlets: Two.
    10. Escutcheon Plate Marking

11. Finish: Polished chrome plated.
12. Outlet Size: NPS 4.

B. Fire Department Connection, Yard Type:

1. Standard: UL 405.
2. Description: Exposed, freestanding.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Corrosion-resistant metal.
5. Inlets: Brass with threads in accordance with NFPA 1963 and matching local fire department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
6. Caps: Brass, lugged type, with gasket and chain.
7. Escutcheon Plate: Round, brass, floor type.
8. Outlet: Bottom, with pipe threads.
9. Number of Inlets: Two (2).

2.5 HOSE CONNECTIONS AND HOSE STATIONS

A. Hose Connections, Adjustable Valve:

1. Standards:
  - a. UL 668.
  - b. UL 1468.
2. Description: Fire hose valve, with integral reducing or restricting pressure-control device, for connecting fire hose.
3. Pressure Rating: 175 psig maximum inlet.
4. Material: Brass or bronze.

B. Hose Connections, Nonadjustable Valve:

1. Standard: UL 668.
2. Description: Fire hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.

2.6 SYSTEM CONTROL VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Valves: 175 psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. System Control Valve, Alarm Valve:

1. Standard: UL 193.
2. Design: For horizontal or vertical installation.
3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, and fill-line attachment with strainer.
4. Drip cup assembly pipe drain

G. System Control Valve, Dry-Pipe Valve:

1. Standards:
  - a. UL 260.
  - b. UL 1486.
2. Design: Differential-pressure type.
3. Include quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
4. Air Compressor for Dry-Pipe Valve:
  - a. Motor Horsepower: Fractional.
  - b. Power: 120 V ac, 60 Hz, single phase.
  - c. Sized for application and capable of achieving system supervisory pressure within 30 minutes in accordance with requirements of NFPA standards. Provide ASME air receiver tank as required to meet requirements on larger systems.
  - d. Include filters, relief valves, coolers, automatic drains, and gauges.

- H. System Control Valve, Deluge Valve:
  - 1. Standard: UL 260.
  - 2. Design: Hydraulically operated, differential-pressure type.
  - 3. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gauges, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer.
  - 4. Wet, Pilot-Line Trim Set: Include gauge to read diaphragm-chamber pressure and manual control station for manual operation of deluge valve, and connection for actuation device.

## 2.7 FIRE-SUPPRESSION PIPING SPECIALTIES

- A. Branch Outlet Fittings:
  - 1. Standard: UL 213.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  - 4. Type: Mechanical-tee and -cross fittings.
- B. Flow Detection and Test Assemblies:
  - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  - 4. Size: Same as connected piping.
  - 5. Inlet and Outlet: Threaded or grooved.
- C. Sprinkler Inspector's Test Fittings:
  - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Body Material: Cast- or ductile-iron housing with sight glass.
  - 4. Size: Same as connected piping.
  - 5. Inlet and Outlet: Threaded.
- D. Flexible Sprinkler Hose Fittings:
  - 1. Standards:
    - a. UL 2443.
    - b. FM 1637.
  - 2. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
  - 3. Pressure Rating: 175 psig minimum.
  - 4. Size: Same as connected piping, for sprinkler.
- E. Automatic (Ball-Drip) Drain Valves:
  - 1. Pressure Rating: 175 psig minimum.
  - 2. Type: Automatic draining, ball check.
  - 3. Size: NPS 3/4.
  - 4. End Connections: Threaded.

## 2.8 COVER SYSTEMS FOR SPRINKLER PIPING

- A. Cover System, Extruded PVC:
  - 1. Description: System of support brackets and covers designed to protect sprinkler piping.
  - 2. Brackets: Per cover manufacturer.
  - 3. Covers: Factory-fabricated extruded-PVC cover with concealed attachment clips.

## 2.9 SPRINKLERS

- A. Standards:
  - 1. UL 199.
  - 2. UL 1767.
  - 3. UL 1626.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- C. Pressure Rating for Sprinklers:
  - 1. Standard Automatic Sprinklers: 175 psig minimum.

- D. Sprinklers, Automatic Wet with Heat-Responsive Element:
    - 1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
    - 2. Standard Spray, Quick Response:
      - a. Upright.
      - b. Pendent.
      - c. Recessed pendent.
      - d. Flat, concealed pendent.
      - e. Vertical sidewall.
      - f. Horizontal sidewall.
      - g. Flat, concealed horizontal sidewall.
  - E. Sprinkler Finishes: bronze.
  - F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
    - 1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
    - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
  - G. Sprinkler Guards and Water Shields:
    - 1. Standard: UL 199.
    - 2. Description: Wire cage with fastening device for attaching to sprinkler.
- 2.10 ALARM DEVICES
- A. Match alarm-device material and connection types to piping and equipment materials and connection types.
  - B. Water-Motor-Operated Alarm:
    - 1. Standard: UL 753.
    - 2. Type: Mechanically operated, with Pelton wheel.
    - 3. Alarm Gong: Cast aluminum with red-enamel factory finish.
    - 4. Size: 8-1/2-inch or 10-inch diameter.
    - 5. Components: Shaft length, bearings, and sleeve to suit wall construction.
    - 6. Inlet: NPS 3/4.
    - 7. Outlet: NPS 1 drain connection.
  - C. Electrically Operated Notification Appliances:
    - 1. Electric Bell:
      - a. Standard: UL 464.
      - b. Type: Vibrating, metal alarm bell.
      - c. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
    - 2. Strobe/Horn:
      - a. Standard: UL 464.
      - b. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
      - c. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police or fire department.
  - D. Water-Flow Indicators:
    - 1. Standard: UL 346.
    - 2. Water-Flow Detector: Electrically supervised.
    - 3. Type: Paddle operated.
    - 4. Pressure Rating: 250 psig.
    - 5. Design Installation: Horizontal or vertical.
  - E. Pressure Switches - Water-Flow Alarm Detection:
    - 1. Description: Electrically supervised, pressure-activated water-flow switch with retard feature.
    - 2. Components: Two single-pole, double-throw switches with normally closed contacts.
    - 3. Design Operation: Rising pressure to 6 psi, plus or minus 2 psi signals water flow.
    - 4. Adjustability: Each switch is to be independently adjustable.
    - 5. Wire Separation: Pressure switch to provide for separation of wiring to each switch connection to allow for low- and high-voltage connections to comply with NFPA 70, Article 760 requirements.

- F. Valve Supervisory Switches:
    - 1. Standard: UL 346.
    - 2. Type: Electrically supervised.
    - 3. Design: Signals that controlled valve is in other than fully open position.
    - 4. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
    - 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - 6. OS&Y Valve Supervisory Switches:
      - a. One or two single-pole, double-throw switches.
      - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
      - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
      - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
      - e. Trip Rod Length: Adjustable
    - 7. Butterfly Valve Supervisory Switches:
      - a. Two single-pole, double-throw switches.
      - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
      - c. Mounting Hardware: Removable nipple.
      - d. Trip Rod Length: Adjustable
    - 8. Ball Valve Supervisory Switches:
      - a. One single-pole, double-throw switch.
      - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
      - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to NPS 2.
  - G. Indicator-Post Supervisory Switches:
    - 1. Type: Electrically supervised.
    - 2. Components: Single-pole, double-throw switch with normally closed contacts.
    - 3. Design: Signals that controlled indicator-post valve is in other than fully open position.
- 2.11 MANUAL CONTROL STATIONS
- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide"
  - B. Description: For hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
  - C. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- 2.12 CONTROL PANELS
- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
    - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
    - 2. Electrical characteristics are 120 V ac, 60 Hz, with 24 V dc rechargeable batteries.
    - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - B. Manual Control Stations, Electric Operation: Metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
  - C. Manual Control Stations, Hydraulic Operation: Provide union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
  - D. Panel Components:
    - 1. Power supply.
    - 2. Battery charger.
    - 3. Standby batteries.
    - 4. Field-wiring terminal strip.



5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.13 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

**PART 3 - EXECUTION**

3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
  1. Flow test is to be performed to meet the criteria established by NFPA 13.
  2. Flow test is to be conducted in accordance with NFPA 291.
  3. Test is to be performed during a period of ordinary demand for the water system.
    - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
  4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
  5. The pitot reading is to range from 10 to 35 psig.
  6. Open additional hydrant outlets as needed to control pitot readings.
  7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
  1. Flow data report is to be written in accordance with NFPA 291.
  2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.
- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.
- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION WATER-SERVICE PIPING

- A. Comply with requirements for fire-suppression water-service piping in Section 33 14 15 "Site Water Distribution Piping."

3.3 INSTALLATION OF DOMESTIC WATER-SUPPLY CONNECTIONS

- A. Connect fire-suppression water piping to building's interior domestic water-distribution piping. Comply with requirements for interior piping in Section 22 11 16 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Section 33 14 15 "Site Water Distribution Piping."

3.4 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of fire-suppression piping.
- C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.
- D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.
- H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards. In seismic-rated areas, refer to Section 21 05 48 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- N. Fill wet-type fire-suppression system piping with water.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 00 "Common Work Results for Fire-Suppression Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 00 "Common Work Results for Fire-Suppression Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 00 "Common Work Results for Fire-Suppression Piping."

### 3.5 INSTALLATION OF PIPING JOINTS

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
  - I. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
  - J. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
    - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
  - K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
  - L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
  - M. Brazed Joints: Join copper tube and fittings in accordance with Copper Development Association's "Copper Tube Handbook," "Braze Joints" chapter.
  - N. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.
  - O. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
  - P. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
  - Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
  - R. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
    - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
    - 2. CPVC Piping: Join in accordance with ASTM D2846/D2846M Appendix.
- 3.6 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS
- A. Install wall-type fire department connections.
  - B. Install yard-type fire department connections in concrete slab support. Comply with requirements for concrete in Section 03 30 00 "Cast-in-Place Concrete."
  - C. Install three protective pipe bollards around each fire department connection. Comply with requirements for bollards in Section 05 50 00 "Metal Fabrications."
  - D. Install automatic (ball-drip) drain valve at each check valve for fire department connection.
- 3.7 INSTALLATION OF HOSE CONNECTIONS AND HOSE STATIONS
- A. Examine roughing-in for hose connections and hose stations to verify actual locations of piping connections before installation.
  - B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and hose stations are to be installed.
  - C. Proceed with installation only after unsatisfactory conditions have been corrected.
  - D. Install hose connections adjacent to standpipes.
  - E. Install freestanding hose connections and hose stations for access and minimum passage restriction.
  - F. Install NPS 1-1/2 hose-connection and hose-station valves with flow-restricting device unless otherwise indicated.
  - G. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device unless otherwise indicated.

- H. Install wall-mounted-type hose connections and wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 10 44 13 "Fire Protection Cabinets."
  - I. Install freestanding hose stations with support or bracket attached to standpipe.
  - J. Install hose-reel hose stations on wall with bracket.
- 3.8 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING
- A. Install cover system, brackets, and cover components for sprinkler piping in accordance with manufacturer's installation manual and in accordance with NFPA 13 or NFPA 13R for supports.
- 3.9 INSTALLATION OF VALVES AND SPECIALTIES
- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
  - B. Install listed fire-suppression system shutoff valves in supervised open position, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.
  - C. System Control Valves:
    - 1. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
    - 2. Install deluge valves with trim sets for drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
  - D. Air Vent:
    - 1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
    - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
    - 3. Pipe from outlet of air vent to drain.
- 3.10 INSTALLATION OF SPRINKLERS
- A. Install sprinklers in suspended ceilings symmetrically in center of acoustical ceiling panels. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
  - B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
  - C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.
- 3.11 IDENTIFICATION
- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 21 05 53 "Identification for Fire-Suppression Piping and Equipment."
  - B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- 3.12 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
  - B. Perform the following tests and inspections:
    - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
    - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - 3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
    - 4. Energize circuits to electrical equipment and devices.
    - 5. Start and run air compressors.
    - 6. Coordinate with fire-alarm tests. Operate as required.
    - 7. Coordinate with fire-pump tests. Operate as required.
    - 8. Verify that equipment hose threads are same as local fire department equipment.

9. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
  - C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
  - D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
  - E. Prepare test and inspection reports.
- 3.13 CLEANING
- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
  - B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.
- 3.14 PIPING SCHEDULE
- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
  - B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
  - C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
  - D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:
    1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
    2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
    3. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
    4. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
    5. Steel pipe with plain ends; welding fittings; and welded joints.
  - E. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), to Be One of the Following:
    1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
    2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
    3. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - F. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:
    1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
    2. Schedule 40, black-steel pipe with cut or roll grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
    3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
    4. Schedule 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
    5. Schedule 10, steel pipe with plain ends; welding fittings; and welded joints.
- 3.15 SPRINKLER SCHEDULE
- A. Use sprinkler types in subparagraphs below for the following applications:
    1. Rooms without Ceilings: Upright sprinklers.
    2. Rooms with Suspended Ceilings: Flat concealed sprinklers.
    3. Wall Mounting: Horizontal sidewall sprinklers.
    4. Spaces Subject to Freezing: Dry sidewall sprinklers.
    5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.

- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.
  2. Recessed Sprinklers: Bright chrome, with factory-painted white escutcheon.
  3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  4. Residential Sprinklers: Dull chrome.

END OF SECTION 21 10 00

## SECTION 22 05 00

### COMMON WORK RESULTS FOR PLUMBING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Motors.
  - 2. Packless expansion joints.
  - 3. Sleeves without waterstop.
  - 4. Sleeves with waterstop.
  - 5. Stack-sleeve fittings.
  - 6. Sleeve-seal systems.
  - 7. Grout.
  - 8. Silicone sealants.
  - 9. Escutcheons.
  - 10. Thermometers, liquid in glass, lead free.
  - 11. Thermowells, lead free.
  - 12. Pressure gauges, dial type, lead free.
  - 13. Gauge attachments, lead free.
  - 14. Test plugs, lead free.
  - 15. Test-plug kits, lead free.

##### 1.2 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product, excluding motors which are included in Part 1 of the plumbing equipment Sections.
    - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
    - b. Include operating characteristics and furnished accessories.
- B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of gauge to include in operation and maintenance manuals.

##### 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

#### 1.7 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water expansion fittings and loops for plumbing piping intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
- C. Capability: Provide products and installations to accommodate maximum axial movement as scheduled or indicated on Drawings.

#### 2.2 MOTORS

- A. Motor Requirements, General:
  - 1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
  - 2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
  - 3. Comply with NEMA MG 1 unless otherwise indicated.
  - 4. Comply with IEEE 841 for severe-duty motors.
- B. Motor Characteristics:
  - 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
  - 2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Polyphase Motors:
  - 1. Description: NEMA MG 1, Design B, medium induction motor.
  - 2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
  - 3. Service Factor: 1.15.
  - 4. Multispeed Motors: Variable torque.
    - a. For motors with 2:1 speed ratio, consequent pole, single winding.
    - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
  - 5. Multispeed Motors, Two Winding: Separate winding for each speed.
  - 6. Rotor: Random-wound, squirrel cage.
  - 7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  - 8. Temperature Rise: Match insulation rating.
  - 9. Insulation: Class F.
  - 10. Code Letter Designation:
    - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
  - 11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- D. Additional Requirements for Polyphase Motors:



1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
  2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
    - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
  3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- E. Single-Phase Motors:
1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
    - a. Permanent-split capacitor.
    - b. Split phase.
    - c. Capacitor start, inductor run.
    - d. Capacitor start, capacitor run.
  2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  4. Motors 1/20 HP and Smaller: Shaded-pole type.
  5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.
- F. Electronically Commutated Motors:
1. Microprocessor-Based Electronic Control Module: Converts 120 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
  2. Three-phase power motor module with permanent magnet rotor.
  3. Digital speed controller/LED display.
  4. Building Automation System Interface.
- 2.3 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- A. Performance Requirements:
1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
  2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.
- B. Grooved-Joint Expansion Joints, Lead Free:
1. Source Limitations: Obtain grooved-joint expansion joints from single manufacturer.
  2. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
  3. Standard: AWWA C606, for grooved joints.
  4. Material: ASTM A53/A53M, Schedule 40 stainless steel pipe with grooved ends.
  5. Couplings: ASTM A312/A312M ductile-iron flexible type for stainless steel pipe dimensions. Include ferrous housing sections, Grade E EPDM rubber gasket or Grade P fluoroelastomer blend gasket, and bolts and nuts.
- 2.4 SLEEVES AND SLEEVE SEALS
- A. Sleeves without Waterstop:
1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
  2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
  3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
  4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
  5. Molded-PVC Sleeves: With nailing flange.
  6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.

- B. Sleeves with Waterstop:
    - 1. Description: Manufactured steel galvanized-steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
  - C. Stack-Sleeve Fittings:
    - 1. Description: Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
      - a. Underdeck Clamp: Clamping ring with setscrews.
  - D. Sleeve-Seal Systems:
    - 1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
      - a. Hydrostatic Seal: 20 psig minimum.
      - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
      - c. Pressure Plates: Carbon steel.
      - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating, ASTM B633 of length required to secure pressure plates to sealing elements.
  - E. Grout:
    - 1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
    - 2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
    - 3. Design Mix: 5000 psi, 28-day compressive strength.
    - 4. Packaging: Premixed and factory packaged.
  - F. Silicone Sealants:
    - 1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
      - a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
    - 2. Silicone Sealant, S, P, T, NT: Single-component, 100/50, pourable, plus 25 percent and minus 25 percent plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
      - a. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.
    - 3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- 2.5 ESCUTCHEONS
- A. Escutcheon Types:
    - 1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
    - 2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
    - 3. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
    - 4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel brass with polished, chrome-plated finish and spring-clip fasteners.
    - 5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
  - B. Floor Plates:
    - 1. Split Floor Plates: Cast brass with concealed hinge.
- 2.6 METERS AND GAUGES FOR PLUMBING PIPING
- A. Thermometers, Bimetallic Actuated, Lead Free:
    - 1. Source Limitations: Provide lead-free bimetallic-actuated thermometers from a single manufacturer.
    - 2. Standard: ASME B40.200.
    - 3. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
    - 4. Dial: Nonreflective aluminum with permanent scale markings and scales in deg F and deg C.
    - 5. Connector Type(s): Union joint, rigid, back and rigid, bottom; with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
    - 6. Stem: 0.25 or 0.375 inch in diameter; lead-free brass.
    - 7. Window: Plain glass .
    - 8. Ring: Stainless steel.
    - 9. Element: Bimetal coil.
    - 10. Pointer: Dark-colored metal.
    - 11. Accuracy: Plus or minus 1 percent of span.

- B. Thermometers, Liquid in Glass, Lead Free - Metal Case, Compact Style:
1. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, compact-style thermometers by single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Cast aluminum; 6-inch nominal size.
  4. Case Form: Back angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid; mercury free.
  6. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
  7. Window: Glass or plastic.
  8. Stem: Aluminum or lead-free brass and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  9. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
  10. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- C. Thermometers, Liquid in Glass, Lead Free - Plastic Case, Compact Style:
1. Source Limitations: Provide liquid-in-glass, lead-free, plastic-case, compact-style thermometers from single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Plastic; 6-inch nominal size.
  4. Case Form: Back angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
  6. Tube Background: Nonreflective with permanent scale markings graduated in deg F and deg C.
  7. Window: Glass or plastic.
  8. Stem: Aluminum or lead-free brass and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  9. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
  10. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- D. Thermometers, Liquid in Glass, Lead Free - Plastic Case, Industrial Style:
1. Source Limitations: Provide liquid-in-glass, lead-free, plastic-case, industrial-style thermometers from single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Plastic; 7-inch nominal size unless otherwise indicated.
  4. Case Form: Adjustable angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
  6. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F and deg C.
  7. Window: acrylic plastic.
  8. Stem: Aluminum, lead-free brass, or stainless steel and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  9. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
  10. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.
- E. Thermowells, Lead Free:
1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  3. Material for Use with Copper Tubing: Lead-free copper.
  4. Material for Use with Steel Piping: Type 304 stainless steel.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, or as required to match threaded opening in pipe.
  7. Internal Threads: Size and thread type as required to match thermometer mounting threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length to extend to center of pipe.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing. Extension is to be of sufficient length to extend beyond the finished insulation surface.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- F. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:
- 1.

2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
  3. Standard: ASME B40.100.
  4. Case: Liquid-filled Sealed type(s); 4-1/2-inch nominal diameter.
  5. Pressure-Element Assembly: Lead-free Bourdon tube.
  6. Pressure Connection: Lead-free brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  7. Movement: Mechanical, with link to pressure element and connection to pointer.
  8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi and kPa.
  9. Pointer: Dark-colored metal.
  10. Window: Safety glass or plastic.
  11. Ring: Stainless steel.
  12. Accuracy: Grade B, plus or minus 2 percent of middle half of span.
- G. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Plastic Case:
1. Source Limitations: Provide dial-type, lead-free, direct-mounted, plastic-case pressure gauges from a single manufacturer.
  2. Standard: ASME B40.100.
  3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
  4. Pressure-Element Assembly: Lead-free Bourdon tube.
  5. Pressure Connection: Lead-free brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Safety glass or acrylic plastic.
  10. Accuracy: Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of span.
- H. Gauge Attachments, Lead Free:
1. Snubbers: ASME B40.100, lead-free brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
  2. Valves: Lead-free brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.
- I. Test Plugs, Lead Free:
1. Source Limitations: Provide lead-free test plugs from single manufacturer.
  2. Description: Test-station fitting made for insertion into piping tee fitting.
  3. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
  4. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
  5. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
  6. Core Inserts: EPDM self-sealing rubber.

### **PART 3 - EXECUTION**

- 3.1 INSTALLATION OF EXPANSION JOINTS, GENERAL
  - A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- 3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS
  - A. Install metal-bellows expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  - B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.
- 3.3 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS
  - A. Install grooved-joint expansion joints to grooved-end steel piping.
- 3.4 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS
  - A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
  - B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

### 3.5 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout or silicone sealant, seal the space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### 3.6 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves. Select to maintain fire resistance of floor/slab/wall.

### 3.7 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

### 3.8 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.9 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

### 3.10 INSTALLATION OF METERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks.
- H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at most readable position.
- I. Install remote-mounted pressure gauges on panel.
- J. Install valve and snubber in piping for each pressure gauge for fluids.
- K. Install test plugs in piping tees.
- L. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Inlets and outlets of each domestic water heat exchanger.
  - 3. Inlet and outlet of each domestic hot-water storage tank.
  - 4. Inlet and outlet of each remote domestic water chiller.
  - 5. Outlet side of hot-water-balancing valve.
  - 6. Each main hot-water-recirculating line return pipe.
- M. Install pressure gauges in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.

### 3.11 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

### 3.12 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

### 3.13 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
  - 1. Perform the following tests and inspections:
    - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
    - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
  - 2. Prepare test and inspection reports.
- B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

### 3.14 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above and below Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  2. Concrete Slabs-on-Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs above Grade:
    - a. stack-sleeve fittings.
  4. Interior Wall and Partitions:
    - a. Sleeves without waterstops.

### 3.15 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
  1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  2. Chrome-Plated Piping: One piece, cast brass with polished, chrome-plated finish.
  3. Insulated Piping:
    - a. One piece, cast brass with polished, chrome-plated finish.
  4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  5. Bare Piping at Ceiling Penetrations in Finished Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  6. Bare Piping in Unfinished Service Spaces:
    - a. One piece, cast brass with polished, chrome-plated finish.
  7. Bare Piping in Equipment Rooms:
    - a. One piece, cast brass with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
  1. Chrome-Plated Piping: Split casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish
  3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
  6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  1. New Piping and Relocated Existing Piping: One piece, floor plate.
  2. Existing Piping: Split floor plate.

### 3.16 THERMOMETER, LEAD FREE, APPLICATION

- A. Thermometers at inlet and outlet of each domestic water heater are to be the following:
  1. Liquid-filled, bimetallic-actuated type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger are to be the following:
  1. Liquid-filled, bimetallic-actuated type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank are to be the following:
  1. Liquid-filled, bimetallic-actuated type.
- D. Thermometer stems are to be of length to match thermowell insertion length.

3.17 THERMOMETER, LEAD FREE, SCALE-RANGE APPLICATION

- A. Scale Range for Domestic Cold-Water Piping:
  - 1. 0 to 100 deg F and minus 20 to plus 50 deg C.
- B. Scale Range for Domestic Hot-Water Piping:
  - 1. 0 to 250 deg F and 0 to 150 deg C.
- C. Scale Range for Domestic Cooled-Water Piping:
  - 1. 0 to 100 deg F and minus 20 to plus 50 deg C.

3.18 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at discharge of each water service into building are to be the following:
  - 1. Liquid filled, mounted, metal case.
- B. Pressure gauges at inlet and outlet of each water pressure-reducing valve are to be the following:
  - 1. Liquid filled, mounted, metal case.
- C. Pressure gauges at suction and discharge of each domestic water pump are to be the following:
  - 1. Liquid filled, mounted, metal case.

3.19 PRESSURE-GAUGE SCALE-RANGE APPLICATION

- A. Scale Range for Water Service Piping:
  - 1. 0 to 160 psi.
- B. Scale Range for Domestic Water Piping:
  - 1. 0 to 100 psi.
- C. Insert additional paragraphs for pressure-gauge scale ranges and applications.

END OF SECTION 22 05 00



## SECTION 22 05 23

### GENERAL-DUTY VALVES FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Bronze ball valves.
  - 2. Ductile-iron, single-flange butterfly valves.
  - 3. Bronze lift check valves.
  - 4. Bronze swing check valves.
  - 5. Bronze gate valves.
  - 6. Iron gate valves

##### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

##### 1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

#### 1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

#### 1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

#### 1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

#### 1.9 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.10 SUBMITTAL DATA

- A. Submittal Requirements:
  1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.

- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
  - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
  - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
  - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
    - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
  - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, and soldered ends.
  3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

**PART 2 - PRODUCTS**

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
  - 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded end valves.
  - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 3. ASME B16.18 for cast copper solder-joint connections.
  - 4. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
  - 5. ASME B16.34 for flanged and threaded end connections
  - 6. ASME B31.9 for building services piping valves.
- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Type:
  - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
  - 2. Hand Lever: For quarter-turn valves smaller than NPS 4.

- G. Valves in Insulated Piping:
  - 1. Provide 2-inch extended neck stems.
  - 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

## 2.3 BRONZE BALL VALVES

- A. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim & Nib-Seal Handle:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-595-Y-66-LF or T-595-Y-66-LF or a comparable product by one of the following:
    - a. Milwaukee Valve Company.
    - b. Apollo.
  - 2. Description:
    - a. Standard: MSS SP-110, NSF 61-G.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Three piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
    - d. Body Material: Bronze ASTM B 584 Alloy C87850 or C87600.
    - e. Ends: Threaded or Solder.
    - f. Seats: PTFE or TFE.
    - g. Stem: 316 Stainless-steel.
    - h. Ball: 316 Stainless-steel, vented.
    - i. Port: Full.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim & Nib-Seal Handle:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-585-66-LF or T-585-66-LF or a comparable product by one of the following:
    - a. Industries, Inc.; Apollo Div.
    - b. Milwaukee Valve Company.
  - 2. Description:
    - a. Standard: MSS SP-110, NSF 61-G.
    - b. CWP Rating: 600 psig.
    - c. Body Design: Two piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
    - d. Body Material: Bronze ASTM B 584 Alloy C87600.
    - e. Ends: Threaded or Solder.
    - f. Seats: PTFE or TFE.
    - g. Stem: 316 Stainless-steel.
    - h. Ball: 316 Stainless-steel, vented.
    - i. Port: Full.
- C. 200 CWP, Sizes 2-1/2" – 24", Ductile Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model LD-2000-3/5, or a comparable product by one of the following:
    - a. Cooper Cameron Corp.; Cooper Cameron Valves Div.
    - b. Tyco International, Ltd.; Tyco Valves & Controls
  - 2. Description:
    - a. Standard: MSS SP-67, Type I, IAPMO.
    - b. NPS 24 (DN 300) and Smaller CWP Rating: 200 psig (1380 kPa).
    - c. Body Design: Full Lug type; Bubble tight shutoff, suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: ASTM A 536, ductile iron.
    - e. Seat: EPDM.
    - f. Stem: One- or two-piece stainless steel.
    - g. Disc: Aluminum bronze

## 2.4 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-480-Y-LF or T-480-Y-LF or a comparable product by one of the following:
    - a. Hammond.

- b. Milwaukee.
- 2. Description:
  - a. Standard: MSS SP-80, Type 2, NSF 61-G.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Vertical flow.
  - d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
  - e. Ends: Threaded or Solder.
  - f. Disc: PTFE, or TFE.

## 2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Nonmetallic TFE Disc:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-413-Y-LF or T-413-Y-LF or a comparable product by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Powell Valves.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 4, NSF 61-G.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Y-pattern Horizontal flow.
    - d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
    - e. Ends: Threaded or Solder.
    - f. Disc: PTFE or TFE.

## 2.6 BRONZE GATE VALVES

- A. NRS Bronze Gate Valves:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-113-LF or T-113-LF or a comparable product by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Powell Valves.
  - 2. Description:
    - a. Standard: MSS SP-139, Type 2, NSF 61-G.
    - b. CWP Rating: 200 psig.
    - c. Body Material: ASTM B 584, dezincification-resistant bronze with integral seat and threaded bonnet.
    - d. Ends: Threaded or Solder.
    - e. Stem: Lead free Silicon Bronze.
    - f. Disc: Solid wedge; lead free bronze.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron.
- B. RS Bronze Gate Valves:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-111-LF or T-111-LF or a comparable product by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Powell Valves
  - 2. Description:
    - a. Standard: MSS SP-80, Type 2, NSF 61-G.
    - b. CWP Rating: 200 psig.
    - c. Body Material: ASTM B584 C87850 dezincification resistant bronze with integral seat and threaded bonnet.
    - d. Ends: Threaded or Solder.
    - e. Stem: Lead free silicon bronze.
    - f. Disc: Solid wedge, lead free bronze.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron.

## 2.7 IRON GATE VALVES

- A. Class 125, Ductile-Iron Resilient Wedge Gate Valves:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-619-RWS (NRS) or F-607-RWS (OS&Y) or a comparable product by one of the following:
    - a. Clow

- b. Mueller
- 2. Description:
  - a. Standard: AWWA C-509 and C-515,
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM A 536 ductile iron, fusion-bonded epoxy coating inside and out.
  - d. Ends: Flanged.
  - e. Trim: stainless-steel.
  - f. Disc: Rubber encapsulated ductile iron wedge.
  - g. Packing and Gasket: Asbestos free.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

#### **3.2 INSTALLATION OF VALVES**

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

#### **3.3 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

#### **3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
  - 2. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 4. For Stainless Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 5. For Stainless Steel Piping, NPS 2 and Smaller: Press ends.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - 150 PSIG OR LESS

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Brass ball valves, two piece with full port, and brass trim.
  - 3. Bronze ball valves, two piece with full port, and bronze or brass trim.
  - 4. Brass ball valves, three piece with full port, and brass trim.
  - 5. Bronze ball valve, three piece with full port, and bronze or brass trim.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Steel ball valves, Class 150 with full port.
  - 3. Iron ball valves, Class 150.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Brass ball valve, one piece. Provide with solder joint ends.
  - 2. Bronze ball valve, one piece with bronze trim. Provide with solder-joint ends.
  - 3. Brass ball valves, two piece with full port, and brass trim. Provide with solder-joint ends.
  - 4. Bronze ball valves, two piece with full port, and bronze or brass trim. Provide with solder-joint ends.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Steel ball valves, Class 150 with full port.
  - 3. Iron ball valves, Class 150.

END OF SECTION 21 05 23



## SECTION 22 05 29

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal hanger-shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Pipe-positioning systems.
  - 8. Equipment supports.

##### 1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
- C. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- D. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- E. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

##### 1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code
  - 2. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.
- C. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- D. Pipe Welding Qualifications: Qualify procedures and operators according to 2021 ASME Boiler and Pressure Vessel Code, Section IX.

#### 1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

#### 1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

#### 1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

#### 1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.

- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

- 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
- 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
- 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
- 4. To be valid, all submittals must:
  - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
  - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
  - c. Include all pertinent construction, installation, performance, and technical data.
  - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
    - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
    - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
  - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

- 1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
  - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
    - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
  - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
- 2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

#### 1.11 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

#### 1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

#### 1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

## 2.2 METAL PIPE HANGERS AND SUPPORTS

### A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

### C. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

## 2.3 TRAPEZE PIPE HANGERS

- ### A.
- Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 THERMAL HANGER-SHIELD INSERTS

### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ERICO International Corporation.
2. PHS Industries, Inc.
3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
4. Piping Technology & Products, Inc.

### B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

### C. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

### D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

### E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

### F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

### A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or stainless steel.
2. Outdoor Applications: Stainless steel.

## 2.6 PIPE STANDS

### A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

### B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Hardware: Galvanized steel or polycarbonate.
  4. Accessories: Protection pads.
- C. Low-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
  4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
  5. Pipe Supports: Clevis hanger.
  6. Hardware: Galvanized steel.
  7. Accessories: Protection pads.
  8. Height: 12 inches above roof.
- D. High-Profile, Single-Base, Single-Pipe Stand:
1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  2. Base: Single vulcanized rubber or molded polypropylene.
  3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
  4. Horizontal Member: One adjustable-height, galvanized-steel, pipe-support slotted channel or plate.
  5. Pipe Supports: Clevis hanger.
  6. Hardware: Galvanized steel.
  7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
  8. Height: 36 inches above roof.
- E. High-Profile, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  2. Bases: Two or more; vulcanized rubber.
  3. Vertical Members: Two or more, galvanized-steel channels.
  4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
  5. Pipe Supports: Clevis hanger.
  6. Hardware: Galvanized steel.
  7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
  8. Height: 36 inches above roof.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.
- 2.7 PIPE-POSITIONING SYSTEMS
- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.
- 2.8 EQUIPMENT SUPPORTS
- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.
- 2.9 MATERIALS
- A. Aluminum: ASTM B221.
  - B. Carbon Steel: ASTM A1011/A1011M.
  - C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
  - D. Stainless Steel: ASTM A240/A240M.
  - E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
    1. Properties: Nonstaining, noncorrosive, and nongaseous.
    2. Design Mix: 5000-psi, 28-day compressive strength.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION**

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

#### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
  - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

- P. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 09 91 13 "Exterior Painting." Section 09 91 23 "Interior Painting" or Section 09 96 00 "High-Performance Coatings."



- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24 requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
  17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
  18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.

19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
  20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

## SECTION 22 05 53

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Warning tape.
  - 4. Pipe labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code
  - 2. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.5 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.6 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.8 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  - 4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.
    - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
      - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
      - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.

- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.
- B. Substitution Requirements:
- 1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
    - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
      - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
    - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
  - 2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
  - 3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
  - 4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
  - 5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
  - 6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.
- 1.9 UNINSPECTED WORK
- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
  - B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.
- 1.10 RECORD DRAWINGS
- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.11 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

**PART 2 - PRODUCTS**

- A. Metal Labels for Equipment:
    - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
    - 2. Letter and Background Color: As indicated for specific application under Part 3.
    - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
    - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
    - 5. Fasteners: Stainless steel rivets or self-tapping screws.
    - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
  - B. Plastic Labels for Equipment:
    - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
    - 2. Letter and Background Color: As indicated for specific application under Part 3.
    - 3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
    - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
    - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
    - 6. Fasteners: Stainless steel rivets or self-tapping screws.
    - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
  - C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- 2.2 WARNING SIGNS AND LABELS
- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
  - B. Letter and Background Color: As indicated for specific application under Part 3.
  - C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
  - D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - F. Fasteners: Stainless steel rivets or self-tapping screws.
  - G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
  - H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
  - I. Label Content: Include caution and warning information plus emergency notification instructions.

### 2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch.
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F.
- F. Minimum Width: 2 inches.

### 2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

### 2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass link chain or beaded chain.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Include valve-tag schedule in operation and maintenance data.

### 2.6 WARNING TAGS

- A. Description: Preprinted accident-prevention tags of plasticized card stock.
  - 1. Size: 3 by 5-1/4 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Letter and Background Color: As indicated for specific application under Part 3.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.



- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
  - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

### 3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

### 3.5 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
  - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 3. Domestic Hot-Water Return Piping: White letters on an ANSI Z535.1 safety-green background.
  - 4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.

### 3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
  - 1. Valve-Tag Size and Shape:
    - a. Domestic Cold Water: 1-1/2 inches
    - b. Domestic Hot Water: 1-1/2 inches
    - c. Domestic Hot-Water Return: 1-1/2 inches.
  - 2. Valve-Tag Colors:
    - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings or schedule.

END OF SECTION 22 05 53

## SECTION 22 07 19

### PLUMBING PIPING INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic chilled-water piping for drinking fountains.
  - 4. Roof drains and rainwater leaders.
  - 5. Supplies and drains for handicap-accessible lavatories and sinks.
  - 6. Condensate drainage for mechanical units.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code
  - 2. Any other legally constituted body having jurisdiction thereof.
  - 3. Water supply and drainpipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories or sinks. TAS Chapter 6.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.
- C. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- D. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
  - 1. Piping Mockups:
    - a. One 10-foot section of NPS 2 straight pipe.
    - b. One each of a 90-degree threaded, welded, and flanged elbow.
    - c. One each of a threaded, welded, and flanged tee fitting.
    - d. One NPS 2 or smaller valve and one NPS 2-1/2 or larger valve.
    - e. Four support hangers, including hanger shield and insert.
    - f. One threaded strainer and one flanged strainer with removable portion of insulation.
    - g. One threaded reducer and one welded reducer.
    - h. One pressure temperature tap.
    - i. One mechanical coupling.
    - j. One union.
  - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 4. Obtain Architect's approval of mockups before starting insulation application.
  - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  7. Demolish and remove mockups when directed.
- E. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.
- 1.4 DRAWINGS
- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
  - B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
  - C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
  - D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.
- 1.5 PROTECTION
- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
  - B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.
- 1.6 LOCATIONS
- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
  - B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
  - C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.
- 1.7 ACTION SUBMITTALS
- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  - 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
  - 3. Sheet Jacket Materials: 12 inches square.
  - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

## 1.8 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  - 4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.
    - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
      - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
      - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
    - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.
- B. Substitution Requirements:
  - 1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
    - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

- 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
    - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
  2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
  3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
  4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
  5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
  6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.
- 1.9 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For qualified Installer.
  - B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
  - C. Field quality-control reports.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size.
- 1.11 COORDINATION
- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
  - C. Coordinate installation and testing of heat tracing.
- 1.12 SCHEDULING
- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- 1.13 UNINSPECTED WORK
- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
  - B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; Micro-Lok.
    - b. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Preformed Pipe Insulation, Type II, Class 1: Unfaced.
  - 3. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ-SSL jacket.
  - 4. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
  - 5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.
- H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
  - 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
  - 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - I. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Johns Manville; Micro-Lok.
      - b. Knauf Insulation; 1000-Degree Pipe Insulation.
      - c. Owens Corning; Fiberglas Pipe Insulation.
    2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ-SSL.
    3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  - J. Phenolic: Fabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.
    1. Pre-fabricated Pipe Insulation: Type III with factory-applied ASJ+ jacket.
    2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
    3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - K. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials, self-seal.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Armacell LLC; Tubolit.
      - b. Nomaco Insulation; IMCOLOCK and NOMALOCK.
- 2.3 INSULATING CEMENTS
- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
  - B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
  - C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
- 2.4 ADHESIVES
- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
  - B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  - C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
    1. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
    2. Wet Flash Point: Below 0 deg F.
    3. Service Temperature Range: 40 to 200 deg F.
    4. Color: Black.
  - D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
  - F. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
  - G. PVC Jacket Adhesive: Compatible with PVC jacket.
- 2.5 MASTICS AND COATINGS
- A. Materials are compatible with insulation materials, jackets, and substrates.
  - B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
    1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
    2. Service Temperature Range: 0 to plus 180 deg F.
    3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
    4. Color: White.
  - C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
    1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
    2. Service Temperature Range: 0 to 180 deg F.



3. Color: White.
  - D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
    1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
    2. Service Temperature Range: Minus 50 to plus 220 deg F.
    3. Color: White.
  - E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
    1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 permat manufacturer's recommended dry film thickness.
    2. Service Temperature Range: 0 to plus 180 deg F.
    3. Color: White.
- 2.6 LAGGING ADHESIVES
- A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
    1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
    2. Service Temperature Range: 20 to plus 180 deg F
    3. Color: White.
- 2.7 SEALANTS
- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
  - B. Joint Sealants:
    1. Permanently flexible, elastomeric sealant.
    2. Service Temperature Range: Minus 58 to plus 176 deg F.
    3. Color: White or gray.
  - C. FSK and Metal Jacket Flashing Sealants:
    1. Fire- and water-resistant, flexible, elastomeric sealant.
    2. Service Temperature Range: Minus 40 to plus 250 deg F.
    3. Color: Aluminum.
  - D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
    1. Fire- and water-resistant, flexible, elastomeric sealant.
    2. Service Temperature Range: Minus 40 to plus 250 deg F.
    3. Color: White.
- 2.8 FACTORY-APPLIED JACKETS
- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
    1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
    2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
    3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
    4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
    5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.
- 2.9 FIELD-APPLIED JACKETS
- A. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
  - B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    2. Adhesive: As recommended by jacket material manufacturer.
    3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  - C. Metal Jacket:
    1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      - b. Finish and thickness are indicated in field-applied jacket schedules.
      - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      - e. Factory-Fabricated Fitting Covers:
        - 1) Same material, finish, and thickness as jacket.
        - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        - 3) Tee covers.
        - 4) Flange and union covers.
        - 5) End caps.
        - 6) Beveled collars.
        - 7) Valve covers.
        - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
    2. Stainless Steel Jacket: ASTM A240/A240M.
      - a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
      - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      - c. Moisture Barrier for Indoor Applications 3-mil-thick, heat-bonded polyethylene and kraft paper.
      - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      - e. Factory-Fabricated Fitting Covers:
        - 1) Same material, finish, and thickness as jacket.
        - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        - 3) Tee covers.
        - 4) Flange and union covers.
        - 5) End caps.
        - 6) Beveled collars.
        - 7) Valve covers.
        - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
  - D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
  - E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.
  - F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
    1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
    2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
    3. Aluminum Finish: Smooth.
- 2.10 FIELD-APPLIED FABRIC-REINFORCING MESH
- A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
  - B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in, in a Leno weave, for pipe.

2.11 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 11.5 mils.
  - 4. Adhesion: 90 ounces force/inch width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches.
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch width.

2.13 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015-inchthick 3/4 inchwide with closed seal.
  - 2. Aluminum: ASTM B20, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inchthick, 3/4 inchwide with closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless-steel, or Monel.
- C. Wire: 0.080-inchnickel-copper alloy.

2.14 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. McGuire Manufacturing.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 milsthick and an epoxy finish 5 milsthick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

#### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.

- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
  - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover

assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

#### A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.

2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  1. Install prefabricated pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
  2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
  2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### 3.9 INSTALLATION OF PHENOLIC INSULATION

- A. General Installation Requirements:
  1. Secure single-layer insulation with stainless steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
  2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.
- B. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.
- C. Insulation Installation on Pipe Flanges:



1. Install prefabricated pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
- D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- E. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
- 3.10 INSTALLATION OF POLYOLEFIN INSULATION
- A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive, or via self-seal mechanism to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- 3.11 INSTALLATION OF FIELD-APPLIED JACKETS
- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.13 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  1. NPS 2 and Smaller: Insulation is one of the following:
    - a. Cellular Glass: 1 inch thick.
    - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
  2. NPS 2-1/2" and Larger: Insulation is one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
    - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.
- B. Domestic Chilled Water (Potable):
  1. All Pipe Sizes: Insulation is one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.

- b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
    - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.
  - C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Flexible Elastomeric: 1/2 inch thick.
      - b. Polyolefin: 1/2 inchthick.
  - D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
    - 1. All Pipe Sizes: Insulation is one of the following:
      - a. Cellular Glass: 1-1/2 inchesthick.
      - b. Flexible Elastomeric: 1 inchthick.
      - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inchthick.
      - d. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inchthick.
      - e. Phenolic: 1 inchthick.
      - f. Polyolefin: 1 inchthick.
  - E. Condensate Piping:
    - 1. All condensate piping within the building shall be insulated with "Imcoa" "Imcolock" 3/4" nominal wall thickness closed-cell insulation. Insulation shall have a flame spread of not more than 25 and a smoke density not exceeding 50 per 2019 CMC. All joints shall be mitered and secured with black duct tape.
- 3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE
  - A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Piping, Concealed:
    - 1. None.
    - 2. PVC, Color-Coded by System: 30 milsthick.
  - D. Piping, Exposed:
    - 1. None.
    - 2. PVC, Color-Coded by System: 30 milsthick.
    - 3. Stainless Steel, Type 316, Smooth No. 2B Finish: 0.020 inch
- 3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE
  - A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Piping, Concealed:
    - 1. None.
    - 2. PVC, Color-Coded by System: 30 milsthick.
  - D. Piping, Exposed:
    - 1. Stainless Steel, Type 316, Smooth No. 2B Finish with Z-Shaped Locking Seam: 0.024 inchthick.
- 3.18 UNDERGROUND, FIELD-APPLIED INSULATION JACKET
  - A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19

## SECTION 22 11 16

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Encasement for piping.
  - 4. Transition fittings.
  - 5. Dielectric fittings.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code
  - 2. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

##### 1.5 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.6 UTILITIES

- A. See Drawings for Points of Connection.
- B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.
- C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.
- D. Domestic Water: The Contractor shall be responsible for the domestic water service outside of the building within five feet (5') of the foundation, and within the building itself. See Civil Engineer's plans for onsite domestic water system.

1.7 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 ACTION SUBMITTALS

- A. Product Data:
  - 1. Pipe and tube.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Transition fittings.

1.11 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.
    - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
      - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
      - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
    - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.
- B. Substitution Requirements:
1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
    - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
      - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
    - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
  2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
  3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
  4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
  5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

#### 1.12 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

#### 1.13 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  1. Notify Architect, Construction Manager and/or Owner no fewer than two days in advance of proposed interruption of water service.
  2. Do not interrupt water service without Architect's, Construction Manager's and/or Owner's written permission.

#### 1.14 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

#### 1.15 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

#### 1.16 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

#### 1.17 WARRANTY

- A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
  1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
  2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Potable-water piping, and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

### 2.2 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mueller Streamline Co.
  - 2. Cerro Flow Products
- B. Drawn-Temper Copper Tube: ASTM B88, Type L.
- C. Annealed-Temper Copper Tube: ASTM B88, Type K.
- D. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- G. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- H. Wrought Copper Unions: ASME B16.22.

### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, 95-5 silver lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

### 2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.
- D. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

<u>Pipe Size / Type</u>	<u>Polywrap Flat Tube Width</u>
1. ½" to ¾" copper	2"
3. 1" to 1-½" copper	3"
4. 2" copper	4"
5. 2-1/2" copper	5"
6. 3" copper	6"

### 2.5 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.



- C. Sleeve-Type Transition Coupling: AWWA C219.
- D. Plastic-to-Metal Transition Fittings:
  - 1. Description:
    - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
    - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
  - 1. Description:
    - a. CPVC or PVC four-part union.
    - b. Brass or stainless-steel threaded end.
    - c. Solvent-cement-joint or threaded plastic end.
    - d. Rubber O-ring.
    - e. Union nut.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  - 1. Standard: ASSE 1079.
  - 2. Pressure Rating: 125 psig minimum at 180 deg F.
  - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Standard: ASSE 1079.
  - 2. Factory-fabricated, bolted, companion-flange assembly.
  - 3. Pressure Rating: 150 psig.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  - 1. Nonconducting materials for field assembly of companion flanges.
  - 2. Pressure Rating: 150 psig.
  - 3. Gasket: Neoprene or phenolic.
  - 4. Bolt Sleeves: Phenolic or polyethylene.
  - 5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
  - 1. Standard: IAPMO PS 66.
  - 2. Electroplated steel nipple complying with ASTM F1545.
  - 3. Pressure Rating and Temperature: 300 psig at 225 deg F.
  - 4. End Connections: Male threaded or grooved.
  - 5. Lining: Inert and noncorrosive, propylene.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  - 1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
  - 1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- F. Under-building-slab, domestic water piping, NPS 2, shall be the following:

1. Drawn-temper or annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
  - G. Aboveground domestic water piping, NPS 2, shall be the following:
    1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
  - H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
    1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
- 3.2 EARTHWORK
- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.
- 3.3 INSTALLATION OF PIPING
- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
  - B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
  - C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
  - D. Install underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.
  - E. Install valves according to the following:
    1. Section 22 05 23 "General-Duty Valves for Plumbing Piping."
  - F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
  - G. Install domestic water piping level without pitch and plumb.
  - H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
  - I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
  - J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
  - K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
  - L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
  - M. Install piping to permit valve servicing.
  - N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
  - O. Install piping free of sags and bends.
  - P. Install fittings for changes in direction and branch connections.
  - Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
  - R. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 22 05 19 "Meters and Gages for Plumbing Piping."
  - S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 11 23 "Domestic Water Pumps."
  - T. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
  - U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
  - V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."

- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut or Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
  - 3. PVC Piping: Join according to ASTM D2855.
- N. Joints for PEX Tubing, ASTM: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- O. Joints for PEX Tubing, ASSE: Join according to ASSE 1061 for push-fit fittings.
- P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

### 3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper tubing and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for reinspection.
    - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  2. Piping Tests:
    - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
    - e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
    - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
    - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

- b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 11 16

## SECTION 22 11 19

### DOMESTIC WATER PIPING SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Temperature-actuated, water mixing valves.
  - 4. Strainers for domestic water piping.
  - 5. Outlet boxes.
  - 6. Hose bibbs.
  - 7. Wall hydrants.
  - 8. Roof hydrants.
  - 9. Drain valves.
  - 10. Water-hammer arresters.
  - 11. Trap-seal primer device.
  - 12. Trap-seal primer systems.
  - 13. Flexible connectors.

##### 1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

##### 1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

#### 1.6 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

#### 1.7 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

#### 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  - 1. Include diagrams for power, signal, and control wiring.

#### 1.9 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.



4. To be valid, all submittals must:
  - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
  - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
  - c. Include all pertinent construction, installation, performance, and technical data.
  - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
    - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
    - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
  - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
  - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
    - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
  - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.10 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    - c. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
    - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - 2. Standard: ASSE 1011.
  - 3. Body: Bronze, nonremovable, with manual drain.
  - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 5. Finish: Rough bronze.

## 2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  2. Standard: ASSE 1013.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psigmaximum, through middle third of flow range.
  5. Size: See plumbing drawings.
  6. Design Flow Rate: See plumbing drawings.
  7. Selected Unit Flow Range Limits: See plumbing drawings.
  8. Pressure Loss at Design Flow Rate: See plumbing drawings.
  9. Body: Bronze for NPS 2and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2and larger.
  10. End Connections: Threaded for NPS 2and smaller; flanged for NPS 2-1/2and larger.
  11. Configuration: See plumbing drawings.
  12. Accessories:
    - a. Valves NPS 2and Smaller: Ball type with threaded ends on inlet and outlet.
    - b. Valves NPS 2-1/2and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    - b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  2. Standard: ASSE 1024.
  3. Operation: Continuous-pressure applications.
  4. Size: See plumbing drawings.
  5. Body: Bronze with union inlet.
- C. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    - b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  2. Standard: ASSE 1052.
  3. Operation: Up to 10-foot head of waterback pressure.
  4. Inlet Size: NPS 3/4.
  5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
  6. Capacity: At least 3-gpm flow.

## 2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Symmons Industries, Inc.
    - b. Bradley Corp.
    - c. Leonard Valve Company.
  2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
  3. Pressure Rating: 125 psigminimum unless otherwise indicated.
  4. Material: Bronze body with corrosion-resistant interior components.
  5. Temperature Control: Adjustable.
  6. Connections: Threaded inlets and outlet.
  7. Finish: Chrome plated.
  8. Tempered-Water Setting: See plumbing drawings.
  9. Tempered-Water Design Flow Rate: See plumbing drawings.
- B. Primary Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Symmons Industries, Inc.
    - b. Bradley Corp.
    - c. Leonard Valve Company.

2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body.
5. Temperature Control: Manual.
6. Connections: Threaded inlets and outlet.
7. Selected Primary Water Tempering Valve Size: See plumbing drawings.
8. Tempered-Water Setting: See plumbing drawings.
9. Tempered-Water Design Flow Rate: See plumbing drawings.
10. Pressure Drop at Design Flow Rate: See plumbing drawings.
11. Tempered-Water Outlet Size: See plumbing drawings.
12. Cold-Water Inlet Size: See plumbing drawings.
13. Hot-Water Inlet Size: See plumbing drawings.
14. Valve Finish: Rough bronze.

## 2.6 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.020 inch
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
  - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

## 2.7 OUTLET BOXES

### A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Acorn Engineering Company.
  - b. Guy Gray Manufacturing Co., Inc.
  - c. IPS Corporation.
  - d. Symmons Industries, Inc.
  - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - f. Whitehall Manufacturing; a div. of Acorn Engineering Company.
  - g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.  
Drain Outlet Connection: NPS 2
5. Accessory: Water hammer arresters.
7. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
8. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
9. Inlet Hoses: Two 60-inch-long, rubber, household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
10. Drain Hose: One 48-inch-long, rubber, household clothes washer drain hose with hooked end.

### B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Acorn Engineering Company.
  - b. IPS Corporation.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Accessory: Water hammer arrestor.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 HOSE STATIONS

- A. Single-Temperature-Water Hose Stations:
1. Standard: ASME A112.18.1.
  2. Cabinet: Stainless steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
  3. Hose-Rack Material: Stainless steel.
  4. Body Material: Bronze with stainless steel wetted parts.
  5. Body Finish: Rough bronze or chrome plated.
  6. Mounting: Wall, with reinforcement.
  7. Supply Fittings: Two NPS 3/4gate, globe, or ball valves and check valves and NPS 3/4copper, water tubing. Omit check valves if check stops are included with fitting.
  8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feetlong.
  9. Nozzle: With hand-squeeze, on-off control.
  10. Vacuum Breaker:
    - a. Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    - b. Garden-hose thread complying with ASME B1.20.7 on outlet.

2.9 HOSE BIBBS

- A. Hose Bibbs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company.
    - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    - c. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
  2. Standard: ASME A112.18.1 for sediment faucets.
  3. Body Material: Bronze.
  4. Seat: Bronze, replaceable.
  5. Supply Connections: NPS 1/2 or NPS 3/4threaded or solder-joint inlet.
  6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
  7. Pressure Rating: 125 psig.
  8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

2.10 WALL HYDRANTS

- A. Nonfreeze Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engneering Company.
    - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    - c. Zurn Industries, LLC; Plumbing Products Group.
  2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
  3. Pressure Rating: 125 psig.
  4. Operation: Loose key.
  5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  6. Inlet: NPS 3/4 or NPS 1.
  7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  8. Box: Deep, flush mounted with cover.
  9. Box and Cover Finish: Polished nickel bronze.
  10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
  12. Operating Keys(s): Two with each wall hydrant.
- B. Nonfreeze Vacuum Breaker Wall Hydrants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company.
    - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    - c. Zurn Industries, LLC; Plumbing Products Group.
  2. Standard: ASSE 1019, Type A or Type B.
  3. Type: Automatic draining with integral air-inlet valve.

4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

## 2.11 ROOF HYDRANTS

### A. Nonfreeze, Draining-Type Roof Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company.
  - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - c. Zurn Industries, LLC; Plumbing Products Group.
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet roof hydrant with coated cast-iron head and lift handle with lock option. Provide with deck flange and under deck clamp.
4. Casing and Operating Rod: Bronze interior parts, galvanized-steel casing, and bronze valve housing designed with hole to drain.
5. Inlet: NPS 3/4.
6. Outlet: Garden-hose thread complying with ASME B1.20.7.
7. Vacuum Breaker:
  - a. Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7 on outlet.

## 2.12 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

### B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

### C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

## 2.13 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Precision Plumbing Products, Inc.
  - b. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MIFAB, Inc.
    - b. Precision Plumbing Products, Inc.
    - c. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
  2. Standard: ASSE 1018.
  3. Pressure Rating: 125 psig minimum.
  4. Body: Bronze.
  5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
  7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.15 TRAP-SEAL PRIMER SYSTEMS

- A. Trap-Seal Primer Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MIFAB, Inc.
    - b. Precision Plumbing Products, Inc.
  2. Standard: ASSE 1044.
  3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
  4. Cabinet: Recessed-mounted steel box with stainless steel cover.
  5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. Vacuum Breaker: ASSE 1001.
  7. Number Outlets: See plumbing drawings.
  8. Size Outlets: NPS 1/2.

2.16 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig
  2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig.
  2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

**PART 3 - EXECUTION**

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- C. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

- D. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 10 00 "Rough Carpentry."
  - E. Ground Hydrants: Install with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
  - F. Nonfreeze, Draining-Type Roof Hydrants: Install with drain connection piped to nearest floor drain or to the exterior.
  - G. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
  - H. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
  - I. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
  - J. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- 3.2 PIPING CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
  - B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- 3.3 ELECTRICAL CONNECTIONS
- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
  - B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
  - C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- 3.4 CONTROL CONNECTIONS
- A. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."
- 3.5 IDENTIFICATION
- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
    - 1. Vacuum breakers.
    - 2. Backflow preventers.
    - 3. Temperature-actuated, water mixing valves.
    - 4. Outlet boxes.
    - 5. Wall hydrants.
    - 6. Roof hydrants.
    - 7. Trap-seal primer device.
    - 8. Trap-seal primer systems.
  - B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- 3.6 ADJUSTING
- A. Set field-adjustable pressure set points of water pressure-reducing valves.
  - B. Set field-adjustable flow set points of balancing valves.
  - C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
  - D. Adjust each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly, and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.



3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections.
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 22 11 19

## SECTION 22 13 16

### SANITARY WASTE AND VENT PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Hubless, cast-iron soil pipe and fittings.
  - 2. Copper tube and fittings.
  - 3. Specialty pipe fittings.
  - 4. Encasement for underground metal piping.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. Any other legally constituted body having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

##### 1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 UTILITIES

- A. See Drawings for Points of Connection.
- B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.
- C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.
- D. Sanitary Sewer: The Contractor shall be responsible for the soil and waste piping inside and outside of the buildings. See Civil Engineer's plans for connection into the sanitary sewer street main or lateral to property as indicated on drawings.

1.8 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.9 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.12 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
  - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
  - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
  - c. Include all pertinent construction, installation, performance, and technical data.
  - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
    - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
    - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
  - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
  - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
    - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
  - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

#### 1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

#### 1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

#### 1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

#### 1.16 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
  1. Notify Architect, Construction Manager, and/or Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
  2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's, and/or Owner's written permission.

#### 1.17 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.
  - 2. Waste, Force-Main Piping: 150 psig
- B. Seismic Performance: Soil, waste, and vent piping and support and installation to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment":
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.5.

### **2.2 PIPING MATERIALS**

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### **2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Charlotte Pipe.
  - 2. Tyler Pipe.
  - 3. AB&I Foundry.
- B. Pipe and Fittings:
  - 1. Marked with CISPI collective trademark.
  - 2. ASTM A888 or CISPI 301.
- C. ASTM C1540 CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ANACO-Husky SD 4000 series.
    - b. Clamp All HI\_TORQ 125 series
  - 2. Standards: ASTM C1277 and CISPI 310.
  - 3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- D. Soil and waste piping within the building itself and outside within five feet (5') of the foundation, shall be no-hub cast iron pipe and fittings, asphaltum coated, free from defects, and shall comply with CISPI. Standard 301, ASTM A-888 or ASTM A-74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. Fittings shall be made up with "Husky" SD 4000 series or "Clamp All" HI-TORQ 125 series stainless steel type 304 couplings and shall conform to ASTM C1540 & ASTM C564 except all above ground vent pipe fittings may be made with "Anaco" or "Tyler" stainless steel two band couplings conforming to CISPI Standard 310.
- E. Except where otherwise indicated on the plans, building sewer piping from five feet (5') outside of the building to connections at the sewer shall be PVC (polyvinyl chloride) ASTM D3034, SDR-35 sewer pipe with locked-in gasket (ASTM F477, Elastomeric Seal)
- F. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe.
    - b. Tyler Pipe.
    - c. AB&I Foundry.
  - 2. Standards: ASTM C1277 and ASTM C1540.
  - 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

### **2.4 COPPER TUBE AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mueller Streamline Co.

2. Cerro Flow Products
  - B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
  - C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
  - D. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
  - E. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.
  - F. Copper Pressure Fittings:
    1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
    2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
  - G. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
    1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
  - H. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.
- 2.5 PVC PIPE AND FITTINGS
  - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Charlotte Pipe.
    2. Tyler Pipe.
    3. AB&I Foundry.
  - B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
  - C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
  - D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
  - E. Adhesive Primer: ASTM F656.
  - F. Solvent Cement: ASTM D2564.
- 2.6 SPECIALTY PIPE FITTINGS
  - A. Transition Couplings:
    1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
    2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
    3. Unshielded, Nonpressure Transition Couplings:
      - a. Standard: ASTM C1173.
      - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      - c. End Connections: Same size as and compatible with pipes to be joined.
      - d. Sleeve Materials:
        - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
        - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
        - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
    4. Shielded, Nonpressure Transition Couplings:
      - a. Standard: ASTM C1460.
      - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
      - c. End Connections: Same size as and compatible with pipes to be joined.
    5. Pressure Transition Couplings:
      - a. Standard: AWWA C219.
      - b. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
      - c. Center-Sleeve Material: Manufacturer's standard.

- d. Gasket Material: Natural or synthetic rubber.
  - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  - 2. Dielectric Unions:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Pressure Rating: 125 psig minimum at 180 deg F.
      - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
  - 3. Dielectric Flanges:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Factory-fabricated, bolted, companion-flange assembly.
      - 3) Pressure Rating: 125 psig minimum at 180 deg F.
      - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  - 4. Dielectric-Flange Insulating Kits:
    - a. Description:
      - 1) Nonconducting materials for field assembly of companion flanges.
      - 2) Pressure Rating: 150 psig
      - 3) Gasket: Neoprene or phenolic.
      - 4) Bolt Sleeves: Phenolic or polyethylene.
      - 5) Washers: Phenolic with steel backing washers.
  - 5. Dielectric Nipples:
    - a. Description:
      - 1) Standard: IAPMO PS 66.
      - 2) Electroplated steel nipple.
      - 3) Pressure Rating: 300 psig at 225 deg F.
      - 4) End Connections: Male threaded or grooved.
      - 5) Lining: Inert and noncorrosive, propylene.

2.7 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Scotchwrap No. 50
  - 2. Polyken No. 900
  - 3. Tapecoat CT
  - 4. Johns-Manville No. V-10
- B. Standard: ASTM A674 or AWWA C105/A 21.5.
- C. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- D. Form: Sheet or tube.
- E. Color: Black or natural.
- F. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

	<u>Pipe Size / Type</u>	<u>Polywrap Flat Tube Width</u>
1.	½" to ¾" copper	2"
2.	1" to 1-½" copper	3"
3.	2" copper	4"
4.	2-1/2" copper	5"
5.	3" copper	6"
6.	2" to 3" cast iron	14"
7.	4" cast iron	16"
8.	6" cast iron	20"
9.	8" cast iron	24"
- G. Piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless-steel bolts.



### **PART 3 - EXECUTION**

#### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

#### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment".
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drainpipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
  - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- O. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- P. Install aboveground PVC piping in accordance with ASTM D2665.
- Q. Install underground ABS and PVC piping in accordance with ASTM D2321.
- R. Install engineered soil and waste and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.

3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
  - S. Install underground, ductile-iron, force-main piping according to AWWA C600.
    1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
    2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
    3. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
  - T. Install underground, copper, force-main tubing in accordance with CDA's "Copper Tube Handbook."
    1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
  - U. Install force mains at elevations indicated.
  - V. Plumbing Specialties:
    1. Install backwater valves in sanitary waster gravity-flow piping.
      - a. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
    2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
      - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
      - b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
    3. Install drains in sanitary waste gravity-flow piping.
      - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  - W. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  - X. Install sleeves for piping penetrations of walls, ceilings, and floors.
    1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
  - Y. Install sleeve seals for piping penetrations of concrete walls and slabs.
    1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
  - Z. Install escutcheons for piping penetrations of walls, ceilings, and floors.
    1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
  - AA. Encasement:
    1. The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. Slip the tube around the pipe, centering it to provide a 1-ft overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at each joint to facilitate installation of the polywrap. The bunched-up polywrap shall be pulled from the preceding length of pipe, slipped over the end of the new length of pipe, and secured in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. The end of the polywrap shall be slipped from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe and tape it in place. The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3-foot intervals along the pipe.
    2. Rips, punctures, or other damage to the tube shall be repaired with the adhesive tape or pieces of tube material secured with tape. Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.
    3. Valves, tees, crosses, and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice, and secured with the adhesive tape.
- 3.3 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:
  - 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
  - 1. Cut threads full and clean using sharp dies.
  - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- F. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- H. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
  - 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- I. Joint Restraints and Sway Bracing:
  - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream, and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
    - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream, and downstream of all changes in direction 45 degrees and greater.
    - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream, and downstream of all changes in direction and branch openings.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
  - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
  - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
  - 4. In Underground Force Main Piping:
    - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
  - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
  - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.
  - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

- A. General valve installation requirements for general-duty valve installation are specified in the following Sections:
  - 1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
  - 2. Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."
  - 3. Section 22 05 23.14 "Check Valves for Plumbing Piping."
  - 4. Section 22 05 23.15 "Gate Valves for Plumbing Piping."

- B. Shutoff Valves:
  - 1. Install shutoff valve on each sewage pump discharge.
  - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
  - 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
  - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
  - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment".
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for cast-iron and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for ABS and PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- F. Support vertical runs of cast-iron and copper soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of ABS and PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
  - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Install horizontal backwater valves with cleanout cover flush with floor.

6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  7. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
  - D. Connect force-main piping to the following:
    1. Sanitary Sewer: To exterior force main.
    2. Sewage Pump: To sewage pump discharge.
  - E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
  - F. Make connections in accordance with the following unless otherwise indicated:
    1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
    2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
- 3.8 IDENTIFICATION
- A. Identify exposed sanitary waste and vent piping.
  - B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- 3.9 FIELD QUALITY CONTROL
- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
    1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.
  - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  - D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
    1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
      - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
    2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
      - a. Expose work that was covered or concealed before it was tested.
    3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
      - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
      - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
      - c. Inspect joints for leaks.
    4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
      - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
      - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
      - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
      - d. Inspect plumbing fixture connections for gas and water leaks.
    5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
    6. Prepare reports for tests and required corrective action.

- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours.
    - b. Leaks and loss in test pressure constitute defects that must be repaired.
  - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller are to be any of the following:
  - 1. Sewer and waste: hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; Heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Vent: hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI, hubless-piping couplings; and coupled joints.
  - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger are to be any of the following:
  - 1. Sewer and waste: hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; Heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Vent: hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI, hubless-piping couplings; and coupled joints.
  - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller is to be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger is to be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings; Heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller are to be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings; Heavy-duty cast-iron hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger are to be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty cast-iron hubless-piping couplings; coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

- H. Aboveground sanitary-sewage force mains NPS 2 and NPS 4 are to be any of the following:
  - 1. Hard copper tube, Type M; copper pressure fittings; and soldered joints.
- I. Underground sanitary-sewage force mains NPS 4 and smaller are to be any of the following:
  - 1. Hard copper tube, Type M; wrought-copper pressure fittings; and soldered joints.
  - 2. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

END OF SECTION 22 13 16

## SECTION 22 14 13

### STORM DRAINAGE PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Hubless, cast-iron soil pipe and fittings.
  - 2. PVC pipe and fittings.
  - 3. Specialty pipe and fittings.
  - 4. Encasement for underground metal piping.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. Any other legally constituted body having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Storm Drainage Piping: 10-foot head of water.

##### 1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.



1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 UTILITIES

- A. See Drawings for Points of Connection.
- B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.
- C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.
- D. Storm Drain: The Contractor shall be responsible for the storm drain service outside of the building within five feet (5') of the foundation, and within the building itself. See Civil Engineer's plans for onsite storm drain system.

1.8 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.9 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.12 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
  - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
  - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
  - c. Include all pertinent construction, installation, performance, and technical data.
  - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
    - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
    - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
  - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
  - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
    - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
  - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

#### 1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

#### 1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

#### 1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

#### 1.16 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  1. Do not proceed with interruption of storm drainage service without Construction Manager's written permission.

### **PART 2 - PRODUCTS**

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  1. Storm Drainage Piping: 10-foot head of water
  2. Storm Drainage, Force-Main Piping: 150 psig.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Charlotte Pipe.
  - 2. Tyler Pipe.
  - 3. AB&I Foundry.
- B. Pipe and Fittings:
  - 1. Marked with CISPI collective trademark and NSF certification mark.
  - 2. Standard: ASTM A 888 or CISPI 301.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ANACO-Husky SD 4000 series.
    - b. Clamp All HI\_TORQ 125 series
  - 2. Standard: ASTM C 1540.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- C. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy fittings or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Charlotte Pipe.
  - 2. Tyler Pipe.
  - 3. AB&I Foundry.
- B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D 2665; drain, waste, and vent.
- D. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- E. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- F. Adhesive Primer: ASTM F 656.
- G. Solvent Cement: ASTM D 2564.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
  - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
  - 3. Unshielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1173.
    - b. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.

- 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- 4. Shielded, Nonpressure Transition Couplings:
  - a. Standard: ASTM C 1460.
  - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - c. End Connections: Same size as and compatible with pipes to be joined.
- 5. Pressure Transition Couplings:
  - a. Standard: AWWA C219.
  - b. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
  - c. Center-Sleeve Material: Carbon steel.
  - d. Gasket Material: Natural or synthetic rubber.
  - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
  - 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  - 2. Dielectric Unions:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Pressure Rating: 150 psig minimum at 180 deg F.
      - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
  - 3. Dielectric Flanges:
    - a. Description:
      - 1) Standard: ASSE 1079.
      - 2) Factory-fabricated, bolted, companion-flange assembly.
      - 3) Pressure Rating: 150 psig minimum at 180 deg F.
      - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  - 4. Dielectric-Flange Insulating Kits:
    - a. Description:
      - 1) Nonconducting materials for field assembly of companion flanges.
      - 2) Pressure Rating: 150 psig.
      - 3) Gasket: Neoprene or phenolic.
      - 4) Bolt Sleeves: Phenolic or polyethylene.
      - 5) Washers: Phenolic with steel-backing washers.
  - 5. Dielectric Nipples:
    - a. Description: Electroplated steel nipple.
    - b. Standard: IAPMO PS 66.
    - c. Pressure Rating: 300 psig at 225 deg F.
    - d. End Connections: Male threaded or grooved.
    - e. Lining: Inert and noncorrosive, propylene.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: High-density, cross laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black.
- E. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

	<u>Pipe Size / Type</u>	<u>Polywrap Flat Tube Width</u>
1.	2" copper	4"
2.	2-1/2" copper	5"
3.	3" copper	6"
4.	2" to 3" cast iron	14"
5.	4" cast iron	16"
6.	6" cast iron	20"
7.	8" cast iron	24"

- F. Piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless-steel bolts.

### **PART 3 - EXECUTION**

#### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

#### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
  - 1. Do not change direction of flow more than 90 degrees.
  - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm Drainage Piping: 1 percent downward in direction of flow.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install aboveground PVC piping according to ASTM D 2665.
- Q. Install underground PVC piping according to ASTM D 2321.
- R. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.
- S. Install underground, ductile-iron, force-main piping according to AWWA C600.
  - 1. Install buried piping inside building between wall and floor penetrations and discharge indirectly into sanitary floor sink when oil sensing controls prohibit oil water from be discharged into system.
  - 2. Otherwise, connection to oil water separator outside building with restrained joints. Continue piping to connect to public sanitary sewer system.
  - 3. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

4. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
  - T. Plumbing Specialties:
    1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
  - U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  - V. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - W. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - X. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- 3.3 JOINT CONSTRUCTION
- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
    1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
  - B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
    1. Cut threads full and clean using sharp dies.
    2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
      - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
      - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
      - c. Do not use pipe sections that have cracked or open welds.
  - C. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
  - D. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
  - E. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
  - F. Joint Restraints and Sway Bracing:
    1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
      - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
      - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
      - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.
- 3.4 SPECIALTY PIPE FITTING INSTALLATION
- A. Transition Couplings:
    1. Install transition couplings at joints of piping with small differences in ODs.
    2. In Drainage Piping: Shielded, nonpressure transition couplings.
    3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
    4. In Underground Force-Main Piping:
      - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
      - b. NPS 2 and Larger: Pressure transition couplings.
  - B. Dielectric Fittings:
    1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
    2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
    3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
    4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

- A. General valve installation requirements for general-duty valve installations are specified in the following Sections:
  - 1. Section 22 05 23.12 "Ball Valves for Plumbing Piping."
  - 2. Section 22 05 23.13 "Butterfly Valves for Plumbing Piping."
  - 3. Section 22 05 23.14 "Check Valves for Plumbing Piping."
  - 4. Section 22 05 23.15 "Gate Valves for Plumbing Piping."
- B. Shutoff Valves:
  - 1. Install shutoff valve on each sump pump discharge.
  - 2. Install full port ball valve for piping NS 2and smaller.
  - 3. Install gate valve for piping NPS 2-1/2and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
  - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
  - 2. Install backwater valves in accessible locations.
  - 3. Comply with requirements for backwater valves specified in Section 22 14 23 "Storm Drainage Piping Specialties."

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install hangers for cast-iron galvanized steel ductile iron and copper soil tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for ABS and PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- F. Support vertical cast-iron galvanized steel ductile iron and copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.
- G. Support vertical ABS and PVC piping with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.



2. Install horizontal backwater valves with cleanout cover flush with floor.
  3. Comply with requirements for backwater valves cleanouts and drains specified in Section 22 14 23 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:
1. Storm Sewer: To exterior force main.
  2. Sump Pumps: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance.
- F. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
- 3.8 IDENTIFICATION
- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- 3.9 FIELD QUALITY CONTROL
- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  3. Test Procedure:
    - a. Test storm drainage piping on completion of roughing-in.
    - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  5. Prepare reports for tests and required corrective action.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  4. Prepare reports for tests and required corrective action.
- D. Piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground and underground storm drainage piping shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
  - 2. Galvanized-steel pipe, drainage fittings, and threaded joints.
  - 3. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
  - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground storm drainage force mains NPS 5 and larger shall be the following:
  - 1. Galvanized-steel pipe, pressure fittings, and threaded joints.
  - 2. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
  - 3. Fitting-type transition couplings if dissimilar pipe materials.
- D. Aboveground and underground storm drainage force mains NPS 4 and smaller shall be the following:
  - 1. Hard copper tube; Type M wrought-copper pressure fittings; and soldered joints.
  - 2. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.
- E. Underground storm drainage force mains NPS 5 and larger shall be any of the following:
  - 1. Ductile-iron, mechanical-joint piping, and mechanical joints.
  - 2. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 22 14 13

## SECTION 22 14 29

### SUMP PUMPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Submersible sump pumps.
  - 2. Sump-pump basins and basin covers.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. National Fire Protection Association.
  - 3. Texas Division of Industrial Safety.
  - 4. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

##### 1.5 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.6 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.7 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  - 4. Include diagrams for power, signal, and control wiring.

1.9 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  - 4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.

- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
  - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
  - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
  - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
    - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
  - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with manufacturer's written instructions for handling.

1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Double-Seal Sump Pumps:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Chicago Pump Company; a division of Yeomans Chicago Corporation.
    - b. Liberty Pumps Company
    - c. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
    - d. Peerless Pump, Inc.
    - e. Weil Pump Company, Inc.
    - f. Yeomans Chicago Corporation.
  - 2. Description: Factory-assembled and -tested sump-pump unit
  - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
  - 4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
  - 5. Impeller: Statically and dynamically balanced, ASTM A48/A48M, Class No. 25 A cast iron design for clear wastewater handling, and keyed and secured to shaft.
  - 6. Pump and Motor Shaft: Stainless-steel, with factory-sealed, grease-lubricated ball bearings.
  - 7. Seals: Mechanical.
  - 8. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.

9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
  - a. Motor Housing Fluid: Oil.
10. Controls:
  - a. Enclosure: NEMA 250, Type 1 (indoors) and Type 4 (outdoors).
  - b. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
  - c. Automatic: Start pump.
  - d. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120 V ac, with transformer and contacts for remote alarm bell.
  - e. Oil sensing switch allowing pumps operation on high or low water levels.
11. Control-Interface Features:
  - a. Remote Alarm Contacts: For remote alarm interface.
  - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
    - 1) On-off status of pump.
    - 2) Alarm status.

### 2.3 SUMP-PUMP CAPACITIES AND CHARACTERISTICS

- A. Unit Capacity: See plumbing drawings and details.
- B. Number of Pumps: One.
- C. Each Pump:
  1. Capacity: See plumbing drawings and details.
  2. Total Dynamic Head: See plumbing drawings and details.
  3. Speed: See plumbing drawings and details.
  4. Discharge Size: See plumbing drawings and details.
  5. Electrical Characteristics:
    - a. Motor Horsepower: See plumbing drawings and details.
    - b. Volts: See plumbing drawings and details.
    - c. Phases: See plumbing drawings and details.
    - d. Hertz: 60.
- D. Unit Electrical Characteristics:
  1. Full-Load Amperes: See plumbing drawings and details.
  2. Minimum Circuit Ampacity: See plumbing drawings and details.
  3. Maximum Overcurrent Protection: See plumbing drawings and details.

### 2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 05 13 "Common Motor Requirements for Plumbing Equipment."
  1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of pumped drainage piping connections before sump pump installation.

### 3.2 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

### 3.3 CONNECTIONS

- A. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 14 29



## SECTION 22 33 00

### ELECTRIC, DOMESTIC-WATER HEATERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Flow-control, electric, tankless, domestic-water heaters.
  - 2. Thermostat-control, electric, tankless, domestic-water heaters.
  - 3. Domestic-water heater accessories.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

##### 1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  - 4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.
    - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
      - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

- 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
  - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.
- B. Substitution Requirements:
1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
    - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
      - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
    - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
  2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
  3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
  4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
  5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
  6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.
- 1.11 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.
- 1.12 COORDINATION
- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- 1.13 UNINSPECTED WORK
- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
  - B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.16 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Five years.
      - 2) Controls and Other Components: Five years.
    - b. Electric, Tankless, Domestic-Water Heaters: Five year(s).
    - c. Expansion Tanks: Five years.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

- A. Flow-Control, Electric, Tankless, Domestic-Water Heaters:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Chronomite Laboratories, Inc.
    - b. Rheem Manufacturing Company.
  - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  - 3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
  - 4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
    - a. Connections: ASME B1.20.1 pipe thread.
    - b. Pressure Rating: 150 psig.

- c. Heating Element: Resistance heating system.
  - d. Temperature Control: Flow-control fitting.
  - e. Safety Control: High-temperature-limit cutoff device or system.
  - f. Jacket: Aluminum or steel with enameled finish or plastic.
  - 5. Support: Bracket for wall mounting.
  - 6. Capacity and Characteristics:
    - a. Flow Rate: 0.35 gpm.
    - b. Maximum Temperature Setting: 120 deg. F.
    - c. Power Demand: See Water Heater Schedule.
    - d. Electrical Characteristics:
      - 1) Volts: See Water Heater Schedule.
      - 2) Phases: See Water Heater Schedule.
      - 3) Hertz: 60 Hz.
      - 4) Full-Load Amperes: See Water Heater Schedule.
      - 5) Minimum Circuit Ampacity: See Water Heater Schedule.
      - 6) Maximum Overcurrent Protection: See Water Heater Schedule.
- B. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Chronomite Laboratories, Inc.
    - b. Rheem Manufacturing Company.
  - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  - 3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
  - 4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
    - a. Connections: ASME B1.20.1 pipe thread.
    - b. Pressure Rating: 150 psig.
    - c. Heating Element: Resistance heating system.
    - d. Temperature Control: Thermostat.
    - e. Safety Control: High-temperature-limit cutoff device or system.
    - f. Jacket: Aluminum or steel with enameled finish or plastic.
  - 5. Support: Bracket for wall mounting.
  - 6. Capacity and Characteristics:
    - a. Flow Rate: 0.35 gpm105 deg F temperature rise.
    - b. Temperature Setting: 120 deg F.
    - c. Power Demand: See Water Heater Schedule.
    - d. Electrical Characteristics:
      - 1) Volts: See Water Heater Schedule.
      - 2) Phases: See Water Heater Schedule.
      - 3) Hertz: 60 Hz.
      - 4) Full-Load Amperes: See Water Heater Schedule.
      - 5) Minimum Circuit Ampacity: See Water Heater Schedule.
      - 6) Maximum Overcurrent Protection: See Water Heater Schedule.

### 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters **at least** 18 inches above floor on wall bracket.
  - 1. Maintain manufacturer's recommended clearances.
  - 2. Arrange units so controls and devices that require servicing are accessible.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  5. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- C. Fill electric, domestic-water heaters with water.
- D. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- 3.2 PIPING CONNECTIONS
- A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.
- 3.3 IDENTIFICATION
- A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- 3.4 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.
- 3.5 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 22 33 00

## SECTION 22 42 00

### COMMERCIAL PLUMBING FIXTURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Commercial lavatories.
  - 2. Commercial showers.
  - 3. Commercial sinks.
  - 4. Commercial urinals.
  - 5. Commercial water closets.
  - 6. Flushometer valves.
  - 7. Toilet seats.
  - 8. Fixture carriers.

##### 1.2 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PMMA: Polymethyl methacrylate; also known as "acrylic."
- C. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- D. High-Efficiency Flush Volume: 1.28 gal. or less per flush.
- E. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for plumbing fixtures.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Plans, elevations, sections, and mounting details.
  - 2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Diagrams for power, signal, and control wiring.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories and/or counter-mounted sinks.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. For lavatories and faucets.
    - a. In addition to items specified provide "Operation and Maintenance Data," include the following:
      - 1) Servicing and adjustments of automatic faucets.
  - 2. For shower valves to include in maintenance manuals
  - 3. For sinks and faucets to include in operation and maintenance manuals.
    - a. In addition to items specified provide "Operation and Maintenance Data," include the following:
      - 1) Servicing and adjustments of automatic faucets.
  - 4. For flushometer valves and electronic sensors to include in operation and maintenance manuals.
  - 5. For wash fountains and components to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Lavatory faucets, sink faucets, shower valves, and wash fountain spray heads and faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 COMMERCIAL LAVATORIES

- A. Lavatory Systems:
  - 1. Lavatory Systems - Single or Multiple Stations LV-1, LV-2 & LV-3:
    - a. Source Limitations: Obtain lavatory systems from single source from single manufacturer.
    - b. Standards:
      - 1) ASME A112.18.1/CSA B125.1.
      - 2) CSA B45.5/IAPMO Z124.
      - 3) NSF 61.
      - 4) NSF 372.
      - 5) UPC, IPC, and GREENGUARD Certified.
    - c. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - d. Bowl(s) and Counter:
      - 1) Material: Solid-surface or natural quartz surface.
      - 2) Height to Rim: Accessible in accordance with ICC A117.1.
      - 3) Color or Finish: See Plumbing Fixture Schedule.
      - 4) Access Panel: 16-1/8-inch access panel.
      - 5) Number of Bowls or User Stations: One, Two, Three
      - 6) Bowl Shape: Trough Rectangular.
      - 7) Drain: Grid with NPS 1-1/2 tailpiece, each bowl.
    - e. Faucets:
      - 1) Type: Manufacturer's standard, chrome-plated solid brass, each bowl/station.
      - 2) Control: AC Power Adapter Transformer Type, control-voltage, sensor-actuated actuation with thermostatic mixing valve with check stops for each bowl or user station.
    - f. Mixer Point-of-Use:
      - 1) Material: Solid bimetal (bronze, brass, stainless steel).
      - 2) Security: Hot limit stop set to a maximum of 109.4 deg F.
      - 3) Set: Screwdriver adjustment temperature dial with scale: Cold-hot.
      - 4) Operation: Electronic "no-touch" wired powered.
      - 5) Power: 120 V ac.
    - g. Mounting: Manufacturer's wall-mounting bracket.
    - h. Supply Fittings:
      - 1) Piping: NPS 1/2 copper tubing, each bowl.
      - 2) Valves: Shutoff valve on each supply.
      - 3) Supply Piping: From wall.
    - i. Waste Fittings:
      - 1) Standard: ASME A112.18.2/CSA B125.2.
      - 2) Trap and Drain Piping: NPS 1-1/2, each basin.
- B. Lavatory Faucets, Manually Operated SK-3:
  - 1. Standard: ASME A112.18.1/CSA B125.1.
  - 2. Operation Type: Two handle, mixing
  - 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  - 4. Body Type: Widespread.
  - 5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
  - 6. Finish: Polished chrome plate.
  - 7. Maximum Flow Rate: 1.2 gpm.



8. Mounting Type: Deck, concealed.
9. Valve Handle(s): Lever handles.
10. Spout: Rigid, gooseneck type.
11. Spout Outlet: Aerator.

C. Lavatory Supply Fittings:

1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
2. Standard: ASME A112.18.1/CSA B125.1.
3. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
4. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
5. Operation: Loose key or Wheel handle.
6. Risers:
  - a. Chrome-plated, soft-copper flexible tube riser.

D. Lavatory Waste Fittings:

1. Standard: ASME A112.18.2/CSA B125.2.
2. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
3. Trap:
  - a. Size: NPS 1-1/2 by NPS 1-1/4.
  - b. Material:
    - 1) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
    - 2) Stainless steel, two-piece trap and swivel elbow with 0.012-inch thick stainless steel tube to wall, and stainless steel wall flange.

2.3 COMMERCIAL SHOWERS

A. Showers, Individual:

B. Shower Valve Assemblies:

1. Shower Valve Assemblies - Single-Handle, Pressure-Balanced Mixing Valve with Head:
  - a. Source Limitations: Obtain shower heads and shower valves from single source from single manufacturer.
  - b. Description: Single-handle, accessible, pressure-balance mixing valve with hot- and cold-water indicators; diverting valve check stops; and hose with handheld shower head on sliding rod shower head.
  - c. Shower Valve:
    - 1) Standards:
      - a) ASME A112.18.1/CSA B125.1.
    - 2) Body Material: Solid brass.
    - 3) Finish: Polished chrome plate.
    - 4) Operation: Single-handle, twist or rotate control.
    - 5) Antiscald Device: Integral with mixing valve.
    - 6) Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
  - d. Supply Connections: NPS 1/2.
  - e. Shower Head:
    - 1) Standard: ASME A112.18.1/CSA B125.1.
    - 2) EPA WaterSense: Required.
    - 3) Shower Head Maximum Flow Rate: 1.5 gpm.
    - 4) Shower Head Material: Metallic with chrome-plated finish.

C. Grout:

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Characteristics: Nonshrink; recommended for interior and exterior applications.
3. Design Mix: 5000 psi, 28-day compressive strength.
4. Packaging: Premixed and factory packaged.

2.4 COMMERCIAL SINKS

A. Utility Sinks:

1. Utility Sinks, Freestanding - Stainless Steel (SK-1):
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Advance Tabco.
    - 2) Elkay.
  - b. Source Limitations: Obtain sinks from single source from single manufacturer.
  - c. Fixture:
    - 1) Standards:
      - a) ASME A112.19.3/CSA B45.4.
      - b) NSF 2.
    - 2) Type: Stainless steel, freestanding, sound-deadened unit with backsplash.
    - 3) Number of Compartments: One.
    - 4) Material: 16 gauge, Type 304 stainless steel.
    - 5) Compartment:
      - a) Drain: NPS 1-1/2 tailpiece with stopper.
      - b) Drain Location: Centered in compartment.
    - 6) Integral Drainboard(s): Both side(s).
  - d. Legs and Feet: Stainless steel tubing legs with adjustable bullet feet.
  - e. Faucet(s): Sink Faucets, Manually Operated.
    - 1) Number Required: One.
    - 2) Mounting: On backsplash.
  - f. Supply Fittings:
    - 1) Standard: ASME A112.18.1/CSA B125.1.
    - 2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      - a) Operation: Loose key Wheel handle.
      - b) Risers: NPS 1/2, chrome-plated, rigid-copper pipe and ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
2. Utility Sinks, Freestanding - Stainless Steel (SK-2):
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Advance Tabco.
    - 2) Elkay.
  - b. Source Limitations: Obtain sinks from single source from single manufacturer.
  - c. Fixture:
    - 1) Standards:
      - a) ASME A112.19.3/CSA B45.4.
      - b) NSF 2.
    - 2) Type: Stainless steel, freestanding, sound-deadened unit with backsplash.
    - 3) Number of Compartments: One.
    - 4) Material: 18 gauge, Type 304 stainless steel.
    - 5) Compartment:
      - a) Drain: NPS 1-1/2 tailpiece with stopper.
      - b) Drain Location: Centered in compartment.
  - d. Legs and Feet: Stainless steel tubing legs with adjustable bullet feet.
  - e. Faucet(s): Manually Operated.
    - 1) Number Required: One.
    - 2) Mounting: On backsplash.
  - f. Supply Fittings:
    - 1) Standard: ASME A112.18.1/CSA B125.1.
    - 2) Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      - a) Operation: Loose key or Wheel handle.
      - b) Risers: NPS 1/2, chrome-plated, rigid-copper pipe ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
    - c)

- g. Waste Fittings:
  - 1) Standard: ASME A112.18.2/CSA B125.2.
  - 2) Trap(s) Size: NPS 1-1/2.
  - 3) Trap(s) Material:
    - a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
    - b) Stainless steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless steel tube to wall; and stainless steel wall flange.
- B. Handwash Sinks:
  - 1. Handwash Sinks:
    - a. Source Limitations: Obtain sinks from single source from single manufacturer.
    - b. Fixture:
      - 1) Standards: ASME A112.19.3/CSA B45.4.
      - 2) Type: Undercounter mounting.
      - 3) Overall Dimensions: 21 by 19 inches.
      - 4) Material: Vitreous china
    - c. Supply Fittings: Comply with requirements in "Sink Supply Fittings" Paragraph.
    - d. Waste Fittings: Comply with requirements in "Sink Waste Fittings" Paragraph.
- C. Sink Faucets, Manually Operated:SK-3
  - 1. Sink Faucets, Manually Operated: Two handle, mixing.
    - a. Source Limitations: Obtain sink faucets from single source from single manufacturer.
    - b. Standards: ASME A112.18.1/CSA B125.1.
    - c. Description: Coordinate faucet inlets with supplies; coordinate outlet with spout and sink receptor.
    - d. Body Type: Widespread.
    - e. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
    - f. Finish: Polished chrome plate.
    - g. Maximum Flow Rate: 1.0 to 1.28 gpm.
    - h. Mounting Type: Deck, concealed.
    - i. Valve Handle(s): Lever.
    - j. Spout Type: Rigid.
    - k. Spout Outlet: Aerator.
  - 2. Sink Faucets, Manually Operated - Service Sink:MS-1
    - a. Source Limitations: Obtain sink faucets from single source from single manufacturer.
    - b. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
    - c. Faucet:
      - 1) Standards:
        - a) ASME A112.18.1/CSA B125.1.
        - b) NSF 61 and NSF 372.
        - c) ICC A117.1.
        - d) ASSE 1001 (VB).
      - 2) Finish: Polished chrome plated.
      - 3) Handles: Lever.
      - 4) Cartridges: Ceramic.
      - 5) Brace: Adjustable top brace.
    - d. Vacuum Breaker: Required for hose outlet.
    - e. Spout Outlet: Hose thread in accordance with ASME B1.20.7.
- D. Sink Faucets, Automatically Operated:LV-1, LV-2, LV-3
  - 1. Sink Faucets, Automatically Operated: Hardwired, electronic sensor operated, nonmixing.
    - a. Source Limitations: Obtain sink faucets from single source from single manufacturer.
    - b. Standards:
      - 1) ASME A112.18.1/CSA B125.1.
      - 2) UL 1951
    - c. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - d. General: coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

- e. Body Type: Single hole.
  - f. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
  - g. Finish: Polished chrome1 plate.
  - h. Maximum Flow Rate: 0.5 gpm.
  - i. Mounting Type: Deck.
  - j. Spout Type: Rigid.
  - k. Spout Outlet: Aerator.
  - l. Thermostatic Mixing Valve: Below deck, Single temperature, with check valves.
- E. Sink Supply Fittings:
- 1. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
  - 2. Standard: ASME A112.18.1/CSA B125.1.
  - 3. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
  - 4. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
  - 5. Operation: Loose key.
  - 6. Risers:
    - a. NPS 3/8.
    - b. Chrome-plated, soft-copper flexible tube ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
- F. Sink Waste Fittings:
- 1. Standard: ASME A112.18.2/CSA B125.2.
  - 2. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
  - 3. Trap:
    - a. Size: NPS 1-1/2.
    - b. Material:
      - 1) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
- G. Grout:
- 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  - 2. Characteristics: Nonshrink; recommended for interior and exterior applications.
  - 3. Design Mix: 5000 psi, 28-day compressive strength.
  - 4. Packaging: Premixed and factory packaged.
- 2.5 COMMERCIAL URINALS
- A. Urinals, Wall Hung:
- 1. Urinals, Wall Hung - Back Outlet, Washout:
    - a. Fixture:
      - 1) Standards:
        - a) ASME A112.19.2/CSA B45.1.
        - b) ASME A112.19.5/CSA B45.15.
      - 2) Material: Vitreous china.
      - 3) Type: Washout with extended shields.
      - 4) Strainer or Trapway: Manufacturer's standard strainer with integral trap.
      - 5) Water Consumption: 0.5 gpf.
      - 6) Spud Size and Location: NPS 3/4, top.
      - 7) Outlet Size and Location: NPS 2, back.
      - 8) Color: White.
    - b. Flushometer Valve:
    - c. Waste Fitting:
      - 1) Standard: ASME A112.18.2/CSA B125.2 for coupling.
      - 2) Size: NPS 2.
    - d. Support: Urinal carrier, floor affixed with steel uprights with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.
    - e. Urinal Mounting Height: Standard and Accessible in accordance with ICC A117.1.

2.6 COMMERCIAL WATER CLOSETS

- A. Water Closets, Floor Mounted:
- B. Water Closets, Wall Mounted:
  - 1. Water Closets, Wall Mounted - Top Spud:
    - a. Source Limitations: Obtain water closets from single source from single manufacturer.
    - b. Standard: ASME A112.19.2/CSA B45.1.
    - c. Bowl:
      - 1) Material: Vitreous china.
      - 2) Type: Siphon jet.
      - 3) Style: Flushometer valve.
      - 4) Mounting Height: Standard Accessible in accordance with ICC A117.1.
      - 5) Rim Contour: Elongated.
      - 6) Water Consumption: 1.28 gal. per flush.
      - 7) Spud Size and Location: NPS 1-1/2; top.
      - 8) Color: White.
    - d. Support: Water-closet carrier, floor affixed.

2.7 FLUSHOMETER VALVES

- A. Flushometer Valves, Sensor Operated:
  - 1. Flushometer Valves, Sensor Operated - Diaphragm:
    - a. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
    - b. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
    - c. Minimum Pressure Rating: 125 psig.
    - d. Features: Include integral check stop and backflow-prevention device.
    - e. Material: Brass body with corrosion-resistant components.
    - f. Style: Exposed.
    - g. Exposed Flushometer-Valve Finish: Chrome-plated.
    - h. Actuator: Side or top mounted; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.
    - i. Trip Mechanism: Hardwired, control-voltage electronic sensor; listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

2.8 TOILET SEATS

- A. Toilet Seats:
  - 1. Source Limitations: Obtain toilet seat from single source from single manufacturer.
  - 2. Standard: IAPMO/ANSI Z124.5.
  - 3. Material: Plastic.
  - 4. Type: Commercial (Heavy duty).
  - 5. Shape: Elongated rim, open front.
  - 6. Hinge: Self-sustaining, check.
  - 7. Hinge Material: Noncorroding metal.
  - 8. Seat Cover: Not required.
  - 9. Color: White.
  - 10. Surface Treatment: Antimicrobial.

2.9 FIXTURE CARRIERS

- A. Fixture Carriers - Lavatory:
  - 1. Source Limitations: Obtain lavatory carriers from single source from single manufacturer.
  - 2. Standards:
    - a. ASME A112.6.1M.
    - b. ASME A112.6.2.
- B. Fixture Carriers - Sink:
  - 1. Source Limitations: Obtain sink carriers from single source from single manufacturer.
  - 2. Standards:
    - a. ASME A112.6.1M.
    - b. ASME A112.6.2.
- C. Fixture Carriers - Urinal:
  - 1. Source Limitations: Obtain urinal carriers from single source from single manufacturer.
  - 2. Standard: ASME A112.6.1M.

3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- D. Fixture Carriers - Water Closet:
1. Source Limitations: Obtain water closet carriers from single source from single manufacturer.
  2. Standard: ASME A112.6.1M.
  3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings, gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in of water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine walls and floors for suitable conditions where plumbing fixtures will be installed.
- C. Examine counters for suitable conditions where lavatories and sinks will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION OF COMMERCIAL PLUMBING FIXTURES**

- A. Lavatory Installation:
1. Install lavatories level and plumb in accordance with roughing-in drawings.
  2. Install supports, affixed to building substrate, for wall-mounted lavatories.
  3. Install accessible, wall-mounted lavatories at mounting height in accordance with ICC A117.1.
  4. Install water-supply piping with stop on each supply to each lavatory faucet. Install stops in locations that are accessible for ease of operation.
  5. Install trap and waste piping on each drain outlet of each lavatory to be connected to sanitary drainage system.
  6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
  7. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
  8. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- B. Shower Installation:
1. Assemble shower components in accordance with manufacturers' written instructions.
  2. Install showers level and plumb in accordance with roughing-in drawings.
  3. Install ball valves in water-supply piping to the shower if supply stops are specified with the shower valve. Comply with ball valve requirements specified in Section 22 05 23 "General Duty Valves for Plumbing Piping." Install valves in locations that are accessible for ease of operation.
  4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
  5. Set shower receptors in leveling bed of cement grout.
  6. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
  7. Seal joints between showers, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- C. Sink Installation:
1. Install sinks level and plumb in accordance with roughing-in drawings.
  2. Install supports, affixed to building substrate, for wall-mounted sinks.
  3. Install accessible, wall-mounted sinks at mounting height in accordance with ICC A117.1.
  4. Set floor-mounted sinks in leveling bed of cement grout.

5. Install water-supply piping with stop on each supply to each sink faucet.
    - a. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 22 05 23 "General Duty Valves for Plumbing Piping."
    - b. Install stops/valves in locations that are accessible for ease of operation.
  6. Install trap and waste piping on each drain outlet of each sink to be connected to sanitary drainage system.
  7. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
  8. Seal joints between sinks, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
  9. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- D. Urinal Installation:
1. Install urinals level and plumb in accordance with roughing-in drawings.
  2. Install wall-hung, back-outlet urinals onto waste-fitting seals and attached to supports.
  3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
  4. Install accessible, wall-mounted urinals at mounting height in accordance with ICC A117.1.
  5. Install trap-seal liquid in waterless urinals.
  6. Install supports, affixed to building substrate, for wall-hung urinals.
  7. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
  8. Use carriers without waste fitting for urinals with tubular waste piping.
  9. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
  10. Measure support height installation from finished floor, not structural floor.
  11. Install flushometer-valve, water-supply fitting on each supply to each urinal.
  12. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  13. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
  14. Install actuators in locations easily reachable for people with disabilities.
  15. Install new batteries in battery-powered, electronic-sensor mechanisms.
  16. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."
  17. Seal joints between urinals, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to urinal color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."
- E. Water Closet Installation:
1. Install water closets level and plumb in accordance with roughing-in drawings.
  2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
  3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.
  4. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
  5. Use carrier supports with waste-fitting assembly and seal.
  6. Install floor-mounted, back-outlet water closets, attached to building floor substrate, onto waste-fitting seals; and attach to support.
  7. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals, and affix to building substrate.
  8. Measure support height installation from finished floor, not structural floor.
  9. Install flushometer-valve, water-supply fitting on each supply to each water closet.
  10. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
  11. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
  12. Install actuators in locations easily reachable for people with disabilities.
  13. Install new batteries in battery-powered, electronic-sensor mechanisms.
  14. Install toilet seats on water closets.
  15. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Install deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 00 "Common Work Results for Plumbing."

16. Seal joints between water closets, walls, and floors using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to water-closet color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

### 3.3 INSTALLATION OF PIPING CONNECTIONS

- A. Connect plumbing fixtures with water supplies and soil, waste, and vent piping. Use size fittings required to match plumbing fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil, waste, and vent piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."
- D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible plumbing fixtures. Comply with requirements in Section 22 07 19 "Plumbing Piping Insulation."
- E. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

### 3.4 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 INSTALLATION OF CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

### 3.6 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.
- C. Adjust water pressure at shower valves to produce proper flow.
- D. Adjust water pressure at flushometer valves to produce proper flow.
- E. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.7 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damages finishes. Replace any fixtures unable to be repaired to the satisfaction of the Architect and Owner.
- B. Clean plumbing fixtures and associated faucets, valves, flushometer valves, and fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and associated faucets, valves, flushometer valves, and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 00



## SECTION 22 47 13

### DRINKING FOUNTAINS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Bottle filling stations.
  - 2. Supports.

##### 1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

##### 1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
  - 1. 2018 International Plumbing Code.
  - 2. County Health Department.
  - 3. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

##### 1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

##### 1.5 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.6 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.7 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain and bottle filling station.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include diagrams for power wiring.

1.9 SUBMITTAL DATA

- A. Submittal Requirements:
  - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
  - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
  - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
  - 4. To be valid, all submittals must:
    - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    - c. Include all pertinent construction, installation, performance, and technical data.
    - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
      - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

- 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
  - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.
- B. Substitution Requirements:
1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
    - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
      - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
    - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
  2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
  3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
  4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
  5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
  6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.
- 1.10 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For drinking fountains and bottle filling stations to include in maintenance manuals.
- 1.11 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.
- 1.12 UNINSPECTED WORK
- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
  - B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
  - 1. Drinking fountains and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
  - 2. Comply with ASME A112.19.3/CSA B45.4 for stainless steel drinking fountains and bottle filling stations.
  - 3. Comply with NSF 42 and NSF 53 for water filters for drinking fountains and bottle filling stations.
  - 4. Comply with ICC A117.1 for accessible drinking fountains and bottle filling stations.

2.2 DRINKING FOUNTAINS

2.3 BOTTLE FILLING STATIONS

- A. Bottle Filling Station - Recessed, Wall-Mounted, Stainless-Steel:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkay Manufacturing Co.
    - b. Haws Corporation.
  - 2. Source Limitations: Obtain recessed, wall-mounted, stainless steel, bottle filling stations from single source from single manufacturer.
  - 3. Type: Vandal resistant and freeze resistant.
  - 4. Cabinet: Stainless-steel.
  - 5. Bottle Filler: Sensor Push-button activation.
  - 6. Drain: Grid type with NPS 1-1/4 tailpiece.
  - 7. Supply: NPS 1/2 with shutoff valve.
  - 8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
  - 9. Filter: One or more water filters complying with NSF 42 and NSF 53 and with capacity sized for peak flow rate.
  - 10. Support: Provide manufacturer's frame attached to substrate.
  - 11. Bottle Filling Station Mounting Height: Accessible in accordance with ICC A117.1.
  - 12. Electrical Characteristics:
    - a. Volts: 120 V ac.
    - b. Phase: Single.
    - c. Hertz: 60 Hz.

2.4 SUPPORTS

- A. Drinking Fountain Carrier:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkay Manufacturing Co.
    - b. Haws Corporation.
  - 2. Standard: ASME A112.6.1M.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install recessed, bottle filling stations secured to wood blocking in wall construction.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 92 00 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for drinking fountain. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplates to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 47 13

## SECTION 230500

### COMMON WORK RESULTS FOR HVAC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Motors.
  - 2. Packed expansion joints.
  - 3. Packless expansion joints.
  - 4. Grooved-joint expansion joints.
  - 5. Alignment guides and anchors.
  - 6. Sleeves without waterstop.
  - 7. Sleeves with waterstop.
  - 8. Stack-sleeve fittings.
  - 9. Sleeve-seal systems.
  - 10. Grout.
  - 11. Silicone sealants.
  - 12. Escutcheons.
  - 13. Thermometers, bimetallic actuated.
  - 14. Thermometers, filled system.
  - 15. Thermometers, liquid in glass.
  - 16. Thermometers, light activated.
  - 17. Duct-thermometer mounting brackets.
  - 18. Thermowells.
  - 19. Pressure gauges, dial type.
  - 20. Gauge attachments.
  - 21. Test plugs.
  - 22. Test-plug kits.
  - 23. Sight flow indicators.
  - 24. Flowmeters.
  - 25. Thermal-energy meters.

##### 1.2 DEFINITIONS

- A. Existing Piping To Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.
    - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
    - b. Include operating characteristics and furnished accessories.
- B. Delegated Design Submittals: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter.

- B. Welding certificates.
  - C. Field quality-control reports.
- 1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For each type of expansion joint, meter, and gauge to include in operation and maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
  - B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.
- 1.7 COORDINATION
- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
    - 1. Motor controllers.
    - 2. Torque, speed, and horsepower requirements of the load.
    - 3. Ratings and characteristics of supply circuit and required control sequence.
    - 4. Ambient and environmental conditions of installation location.

## **PART 2 - PRODUCTS**

### **2.1 MOTORS**

- A. Motor Requirements, General:
  - 1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
  - 2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
  - 3. Comply with NEMA MG 1 unless otherwise indicated.
  - 4. Comply with IEEE 841 for severe-duty motors.
- B. Motor Characteristics:
  - 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
  - 2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Polyphase Motors:
  - 1. Description: NEMA MG 1, Design B, medium induction motor.
  - 2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
  - 3. Service Factor: 1.15.
  - 4. Multispeed Motors: Variable torque.
    - a. For motors with 2:1 speed ratio, consequent pole, single winding.
    - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
  - 5. Multispeed Motors, Two Winding: Separate winding for each speed.
  - 6. Rotor: Random-wound, squirrel cage.
  - 7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  - 8. Temperature Rise: Match insulation rating.
  - 9. Insulation: Class F.
  - 10. Code Letter Designation:
    - a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
    - b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.
  - 11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- D. Additional Requirements for Polyphase Motors:
  - 1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.



2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
    - a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
    - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
    - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
  3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- E. Single-Phase Motors:
1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
    - a. Permanent-split capacitor.
    - b. Split phase.
    - c. Capacitor start, inductor run.
    - d. Capacitor start, capacitor run.
  2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  4. Motors 1/20 hp and Smaller: Shaded-pole type.
  5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.
- F. Electronically Commutated Motors:
1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
  2. Three-phase power motor module with permanent magnet rotor.
  3. Circuit board or digital speed controller/LED display.
  4. Building Automation System Interface: Via AC voltage signal DC voltage signal or Digital Serial Interface (DSI).
- ## 2.2 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
- A. Performance Requirements:
1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
  2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.
- B. Packed Expansion Joints:
1. Flexible, Ball-Joint Packed Expansion Joints: FBJ-01.
    - a. Source Limitations: Obtain rubber union connector expansion joints from single manufacturer.
    - b. Standards: 2021 ASME Boiler and Pressure Vessel Code: Section II, "Materials"; ASME B31.9 for materials and design of pressure-containing parts and bolting.
    - c. Material: Carbon-steel assembly with asbestos-free composition packing.
    - d. Design: Provide 360-degree rotation and angular deflection.
    - e. Minimum Pressure Rating: 250 psig at 400 deg F.
    - f. Angular Deflection for NPS 6 (DN 150) and Smaller: 30 degrees minimum.
    - g. Angular Deflection for NPS 8 (DN 200) and Larger: 15 degrees minimum.
    - h. Seal Type: Two carbon-steel and graphite seals suitable for continuous operation at temperature up to 650 deg F.
    - i. Internal Ball: Plated with minimum 1-mil chrome cover.
    - j. Ball Socket: One- or two-piece design with integral socket/retainer.
      - 1) Stuffing Box: Incorporates containment seals and compression seals for containment of injectable packing.
      - 2) Packing Cylinders: Provides packing under full line pressure with check valves to prevent blowback.
    - k. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
    - l. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2. Slip-Joint Packed Expansion Joints: SJ-01.
  - a. Source Limitations: Obtain slip-joint packed expansion joints from single manufacturer.
  - b. Standard: ASTM F1007.
  - c. Material: Carbon steel with asbestos-free PTFE packing.
  - d. Design: With internal guide and injection ports for repacking under full system pressure. Housing is to be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
  - e. Configuration: Single joint single joint with base and double joint with base class(es) unless otherwise indicated.
  - f. Slip Tube for Sizes NPS 1-1/2 (DN 40) through NPS 16 (DN 400): Schedule 80.
  - g. Slip Tube for Sizes NPS 18 (DN 450) through NPS 24 (DN 600): Schedule 60.
  - h. Sliding Surface: 2-mil-thick chrome finish.
  - i. End Connections: Flanged or welded ends to match piping system.
- C. Packless Expansion Joints:
  1. Metal, Compensator Packless Expansion Joints: MCEJ-01.
    - a. Source Limitations: Obtain metal compensator packless expansion joints from single manufacturer.
    - b. Minimum Pressure Rating: 150 psig unless otherwise indicated.
    - c. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
    - d. Joint Axial Movement: 2 inches of compression and 1/2 inch of extension.
    - e. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.
      - 1) End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.
      - 2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.
    - f. Configuration for Steel Piping: Multi-ply, stainless steel bellows; steel-pipe end connections; and carbon-steel shroud.
      - 1) End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
      - 2) End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged Threaded Welded.
  2. Rubber Union Connector Expansion Joints: RUEJ-01.
    - a. Source Limitations: Obtain rubber union connector expansion joints from single manufacturer.
    - b. Material: Twin reinforced-rubber spheres with external restraining cables.
    - c. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
    - d. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
    - e. End Connections for Greater than NPS 2 (DN 50): Flanged.
  3. Flexible-Hose Packless Expansion Joints: FHEJ-01.
    - a. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
    - b. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
    - c. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
    - d. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.
      - 1) Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
      - 2) Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
    - e. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
      - 1) Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
      - 2) Stainless steel hoses and double-braid, stainless steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

- f. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Carbon-steel fittings with threaded end connections.
  - 1) Retain one of first two subparagraphs below, or both, to suit pressure and temperature requirements of systems in which these devices are installed. If retaining both, indicate location of each on Drawings.
  - 2) Stainless steel hoses and single-braid, stainless steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
  - 3) Stainless steel hoses and double-braid, stainless steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
- g. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with flanged end connections.
  - 1) Retain one of first two subparagraphs below, or both, to suit pressure and temperature requirements of systems in which these devices are installed. If retaining both, indicate location of each on Drawings.
  - 2) Stainless steel hoses and single-braid, stainless steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
  - 3) Stainless steel hoses and double-braid, stainless steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
- h. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Carbon steel fittings with flanged end connections.
  - 1) Retain one of first two subparagraphs below, or both, to suit pressure and temperature requirements of systems in which these devices are installed. If retaining both, indicate location of each on Drawings.
  - 2) Stainless steel hoses and single-braid, stainless steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
  - 3) Stainless steel hoses and double-braid, stainless steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
- i. Expansion Joints for Steel Piping NPS 14 (DN 350) and Larger: Carbon-steel fittings with flanged end connections.
  - 1) Stainless steel hoses and double-braid, stainless steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
- 4. Metal-Bellows Packless Expansion Joints: MBEJ-01.
  - a. Source Limitations: Obtain metal-bellows packless expansion joints from single manufacturer.
  - b. Standards: ASTM F1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  - c. Type: Circular, corrugated bellows with external tie rods.
  - d. Minimum Pressure Rating: 150 psig unless otherwise indicated.
  - e. Configuration: Single joint Single joint with base and double joint with base class(es), unless otherwise indicated.
  - f. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - 1) End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.
    - 2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint or threaded.
    - 3) End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.
  - g. Expansion Joints for Steel Piping: Single- or multi-ply stainless steel bellows, steel pipe ends, and carbon steel shroud.
    - 1) End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
    - 2) End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.
- 5. Externally Pressurized Metal-Bellows Packless Expansion Joints: EPEJ-01.
  - a. Source Limitations: Obtain externally pressurized metal-bellows packless expansion joints from single manufacturer.
  - b. Minimum Pressure Rating: 150 psig unless otherwise indicated.
  - c. Description:
    - 1) Totally enclosed, externally pressurized, multi-ply, stainless steel bellows isolated from fluid flow by an internal pipe sleeve.
    - 2) Carbon-steel housing.
    - 3) Drain plugs and lifting lug for NPS 3 and larger.

- 4) Bellows: With operating clearance between internal pipe sleeves and external shrouds.
- 5) Joints: Supplied with a built-in scale to confirm the starting position and operating movement.
- 6) Joint Axial Movement: 4 inches of compression and 3/4 inch of extension.
- d. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are unacceptable.
- e. End Connection Configuration: Flanged; one raised, fixed and one floating flange.
6. Rubber Packless Expansion Joints: REJ-01.
  - a. Source Limitations: Obtain rubber packless expansion joints from single manufacturer.
  - b. Standards: ASTM F1123 and FSA's "Expansion Joints - Piping Technical Handbook."
  - c. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
  - d. Arch Type: Single or multiple arches with external control rods.
  - e. Spherical Type: Single or multiple spheres with external control rods.
  - f. Minimum Pressure Rating for NPS 1-1/2 to NPS 12 (DN 40 to DN 300): 225 psig at 170 deg F.
  - g. Material for Fluids Containing Acids, Alkalis, or Chemicals: Butyl rubber Chlorosulfonyl-polyethylene rubber EPDM rubber.
  - h. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N Chlorosulfonated polyethylene synthetic rubber.
  - i. Material for Water: Butyl rubber Buna-N Chlorosulfonated polyethylene synthetic rubber Chlorosulfonyl-polyethylene rubber EPDM rubber Natural rubber.
  - j. End Connections: Full-faced, integral steel flanges with steel retaining rings.
- D. Grooved-Joint Expansion Joints:
  1. Source Limitations: Obtain grooved-joint expansion joints from single manufacturer.
  2. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
  3. Standard: AWWA C606, for grooved joints.
  4. Materials: Galvanized, ASTM A53/A53M, Schedule 40, Type E or S, steel pipe with grooved ends.
  5. Couplings: Five, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket, , EPDM rubber gasket, and bolts and nuts.
- E. Alignment Guides and Anchors:
  1. Alignment Guides: AG-01.
    - a. Source Limitations: Obtain alignment guides from single manufacturer.
    - b. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe. Provide dielectric spacer for use with copper tubing/piping.
  2. Anchor Materials:
    - a. Steel Shapes and Plates: ASTM A36/A36M.
    - b. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
    - c. Washers: ASTM F844, steel, plain, flat washers.
    - d. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
      - 1) Stud: Threaded, zinc-coated carbon stainless steel.
      - 2) Expansion Plug: Zinc-coated carbon Stainless steel.
      - 3) Washer and Nut: Zinc-coated carbon Stainless steel.
    - e. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
      - 1) Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
      - 2) Stud: ASTM A307, zinc-coated carbon stainless steel with continuous thread on stud, unless otherwise indicated.
      - 3) Washer and Nut: Zinc-coated carbon Stainless steel.

## 2.3 SLEEVES AND SLEEVE SEALS

- A. Sleeves without Waterstop:
1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
  2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
  3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
  4. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
  5. Molded-PVC Sleeves: With nailing flange.
  6. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Sleeves with Waterstop:
1. Description: Manufactured PVC/HDPE steel stainless steel galvanized-steel, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
- C. Stack-Sleeve Fittings:
1. Description: Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
    - a. Underdeck Clamp: Clamping ring with setscrews.
- D. Sleeve-Seal Systems:
1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
    - a. Hydrostatic seal: 20 psig.
    - b. Sealing Elements: EPDM-rubber High-temperature-silicone Nitrile (Buna-N) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
    - c. Pressure Plates: Carbon steel Composite plastic Stainless steel Stainless steel, Type 316.
    - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating. ASTM B633 Stainless steel Stainless steel, Type 316, of length required to secure pressure plates to sealing elements.
- E. Grout:
1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
  2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  3. Design Mix: 5000 psi, 28-day compressive strength.
  4. Packaging: Premixed and factory packaged.
- F. Silicone Sealants:
1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
    - a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
  2. Silicone Sealant, S, P, T, NT: Single-component, 25, pourable, movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
    - a. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
  3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## 2.4 ESCUTCHEONS

- A. Escutcheon Types:
1. One-Piece, Steel Type: With polished, chrome-plated polished brass finish and setscrew fastener.
  2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
  3. One-Piece, Cast-Brass Type: With polished, chrome-plated polished brass finish and setscrew fastener.
  4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel brass with polished, chrome-plated finish and spring-clip fasteners.
  5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
  6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.
- B. Floor Plates:
1. Split Floor Plates: Steel with concealed hinge.

2.5 METERS AND GAUGES FOR HVAC PIPING

A. Thermometers, Bimetallic Actuated:

1. Source Limitations: Provide bimetallic-actuated thermometers from a single manufacturer.
2. Standard: ASME B40.200.
3. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
4. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
5. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
6. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
7. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
8. Window: Plain glass or plastic.
9. Ring: Stainless steel.
10. Element: Bimetal coil.
11. Pointer: Dark-colored metal.
12. Accuracy: Plus or minus 1 percent of scale range.

B. Thermometers, Filled System - Direct-Mounted, Metal-Case, Vapor-Actuated:

1. Source Limitations: Provide filled-system, direct-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

C. Thermometers, Filled System - Direct-Mounted, Plastic-Case, Vapor-Actuated:

1. Source Limitations: Provide filled-system, direct-mounted, plastic-case, vapor-actuated thermometers from single manufacturer.
2. Standard: ASME B40.200.
3. Case: Sealed type, plastic; 4-1/2-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal or plastic.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

D. Thermometers, Filled-System - Remote-Mounted, Metal-Case, Vapor-Actuated:

1. Source Limitations: Provide filled-system, remote-mounted, metal-case, vapor-actuated thermometers from a single manufacturer.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.

6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  7. Pointer: Dark-colored metal.
  8. Window: Glass or plastic.
  9. Ring: Metal.
  10. Connector Type(s): Union joint, back; with ASME B1.1 screw threads.
  11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  12. Accuracy: Plus or minus 1 percent of scale range.
- E. Thermometers, Filled System - Remote-Mounted, Plastic-Case, Vapor-Actuated:
1. Source Limitations: Provide filled-system, remote-mounted, plastic-case, vapor-actuated thermometers from a single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Sealed type, plastic; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
  4. Element: Bourdon tube or other type of pressure element.
  5. Movement: Mechanical, with link to pressure element and connection to pointer.
  6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  7. Pointer: Dark-colored metal.
  8. Window: Glass or plastic.
  9. Ring: Metal or plastic.
  10. Connector Type(s): Union joint, threaded, back; with ASME B1.1 screw threads.
  11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- F. Thermometers, Liquid-in-Glass - Metal Case, Compact Style:
1. Source Limitations: Provide liquid-in-glass, metal-case, compact-style thermometers by single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Cast aluminum; 6-inch nominal size.
  4. Case Form: Back angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue organic liquid.
  6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  7. Window: Glass or plastic.
  8. Stem: Aluminum or brass and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  9. Connector: 3/4 inch, with ASME B1.1 screw threads.
  10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- G. Thermometers, Liquid in Glass - Plastic Case, Compact Style:
- Source Limitations: Provide liquid-in-glass, plastic-case, compact-style thermometers from single manufacturer.
1. Standard: ASME B40.200.
  2. Case: Plastic; 6-inch nominal size.
  3. Case Form: Back angle unless otherwise indicated.
  4. Tube: Glass with magnifying lens and blue organic liquid.
  5. Tube Background: Nonreflective with permanently etched scale markings graduated in deg F.
  6. Window: Glass or plastic.
  7. Stem: Aluminum or brass and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  8. Connector: 3/4 inch, with ASME B1.1 screw threads.

9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- H. Thermometers, Liquid in Glass - Metal Case, Industrial Style:
1. Source Limitations: Provide liquid-in-glass, metal-case, industrial-style thermometers from single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
  4. Case Form: Adjustable angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue organic liquid.
  6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  7. Window: Glass or plastic.
  8. Stem: Aluminum and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- I. Thermometers, Liquid in Glass - Plastic Case, Industrial Style:
1. Source Limitations: Provide liquid-in-glass, plastic-case, industrial-style thermometers from single manufacturer.
  2. Standard: ASME B40.200.
  3. Case: Plastic; 7-inch nominal size unless otherwise indicated.
  4. Case Form: Adjustable angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid.
  6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  7. Window: Glass or plastic.
  8. Stem: Aluminum, brass, or stainless steel and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.
- J. Thermometers, Light Activated - Direct Mounted:
1. Source Limitations: Provide light-activated, direct-mounted thermometers from single manufacturer.
  2. Case: Plastic; 7-inch nominal size unless otherwise indicated.
  3. Scale(s): Deg F.
  4. Case Form: Adjustable angle.
  5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  6. Stem: Aluminum and of length to suit installation.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  7. Display: Digital.
  8. Accuracy: Plus or minus 2 deg F.
- K. Thermometers, Light Activated - Remoted Mounted:
1. Source Limitations: Provide light-activated, remote-mounted thermometers from single manufacturer.
  2. Case: Plastic, for wall mounting.
  3. Scale(s): Deg F.
  4. Sensor: Bulb and thermister wire.
    - a. Design for Air-Duct Installation: With ventilated shroud.
    - b. Design for Thermowell Installation: Bare stem.
  5. Display: Digital.
  6. Accuracy: Plus or minus 2 deg F.
- L. Duct-Thermometer Mounting Brackets:
1. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.



- M. Thermowells:
1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
  3. Material for Use with Copper Tubing: CNR or CUNI.
  4. Material for Use with Steel Piping: CRES CSA.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length required to match thermometer bulb or stem.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
  12. Heat-Transfer Medium: Mixture of graphite and glycerin.
- N. Pressure Gauges, Dial Type - Direct Mounted, Metal Case:
1. Source Limitations: Provide dial-type, direct-mounted, metal-case pressure gauges from single manufacturer.
  2. Standard: ASME B40.100.
  3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube.
  5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass Safety glass or acrylic plastic.
  10. Ring: Metal.
  11. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- O. Pressure Gauges, Dial Type - Direct Mounted, Plastic Case:
1. Source Limitations: Provide dial-type, direct-mounted, plastic-case pressure gauges from a single manufacturer.
  2. Standard: ASME B40.100.
  3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube.
  5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass Safety glass or acrylic plastic.
  10. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- P. Pressure Gauges, Dial Type - Remote Mounted, Metal Case:
1. Source Limitations: Provide dial-type, remote-mounted, metal-case pressure gauges from a single manufacturer.
  2. Standard: ASME B40.100.
  3. Case: Liquid-filled type; cast aluminum or drawn steel; 3-1/2-inch nominal diameter with back flange and holes for panel mounting.
  4. Pressure-Element Assembly: Bourdon tube.
  5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass Safety glass or acrylic plastic.
  10. Ring: Metal.
  11. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- Q. Pressure Gauges, Dial Type - Remote Mounted, Plastic Case:
1. Source Limitations: Provide dial-type, remote-mounted, plastic-case pressure gauges from single manufacturer.

2. Standard: ASME B40.100.
  3. Case: Sealed type; plastic; 3-1/2-inch nominal diameter with back flange and holes for panel mounting.
  4. Pressure-Element Assembly: Bourdon tube.
  5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass Safety glass or acrylic plastic.
  10. Accuracy: Grade A, plus or minus 1 percent of middle half of span.
- R. Gauge Attachments:
1. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
  2. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.
  3. Valves: Brass ball Brass or stainless steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.
- S. Test Plugs:
1. Source Limitations: Provide test plugs from single manufacturer.
  2. Description: Test-station fitting made for insertion in piping tee fitting.
  3. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
  4. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
  5. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
  6. Core Inserts: Chlorosulfonated polyethylene synthetic EPDM self-sealing rubber.
- T. Test-Plug Kits:
1. Source Limitations: Provide test-plug kits from single manufacturer.
  2. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes are to be of diameter to fit test plugs and of length to project into piping.
  3. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range is to be at least 25 to 125 deg F.
  4. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range is to be at least 0 to 220 deg F.
  5. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
  6. Carrying Case: Metal or plastic, with formed instrument padding.
- U. Sight Flow Indicators:
1. Source Limitations: Provide sight flow indicators from single manufacturer.
  2. Description: Piping inline-installation device for visual verification of flow.
  3. Construction: Bronze or stainless steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
  4. Minimum Pressure Rating: 125 psig.
  5. Minimum Temperature Rating: 200 deg F.
  6. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
  7. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.
- V. Flowmeters:
1. Performance Requirements: Manufacturer is to certify that each flowmeter complies with specified performance requirements and characteristics.
  2. Flowmeters - Orifice:
    - a. Source Limitations: Provide orifice flowmeters from single manufacturer.
    - b. Description: Flowmeter with orifice plate and flanges, differential pressure sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.
    - c. Flow Range: Sensor and indicator are to cover operating range of equipment or system served.
    - d. Orifice Plate: Wafer-orifice-type, calibrated, flow-measuring element; for installation between orifice plate pipe flanges.
      - 1) Design: Differential-pressure-type measurement for water.

- 2) Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
      - 3) Minimum Pressure Rating: 300 psig.
      - 4) Minimum Temperature Rating: 250 deg F.
    - e. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected sensor, and has 6-inch-diameter, or equivalent, dial with fittings and copper tubing for connecting to sensor.
      - 1) Scale Divisions: gpm.
      - 2) Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
    - f. Portable Indicators: Handheld, differential-pressure type, calibrated for connected sensor and having two 12 ft. hoses, with carrying case.
      - 1) Scale Divisions: gpm.
      - 2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
    - g. Display: Shows rate of flow, with register to indicate total volume in gallons.
    - h. Conversion Chart: Flow rate data compatible with sensor and indicator.
    - i. Operating Instructions: Include complete instructions with each flowmeter.
  3. Flowmeters - Pitot Tube:
    - a. Source Limitations: Provide pitot-tube flowmeters from single manufacturer.
    - b. Description: Flowmeter with sensor and indicator.
    - c. Flow Range: Sensor and indicator are to cover operating range of equipment or system served.
    - d. Sensor: Insertion type; for inserting probe in piping and measuring flow directly in gpm.
      - 1) Design: Differential-pressure-type measurement for oil water.
      - 2) Construction: Stainless steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
      - 3) Fitting for mounting probe in pipe, with weld or threaded connection for attachment to pipe. Provide way to permit removal of probe for service.
      - 4) Minimum Pressure Rating: 150 psig.
      - 5) Minimum Temperature Rating: 250 deg F.
    - e. Indicator: Handheld meter; either an integral part of sensor or a separate meter.
    - f. Integral Transformer: For low-voltage power connection.
    - g. Accuracy: Plus or minus 3 percent.
    - h. Display: Shows rate of flow, with register to indicate total volume in gallons.
    - i. Operating Instructions: Include complete instructions with each flowmeter.
  4. Flowmeters - Turbine:
    - a. Source Limitations: Provide turbine flowmeters from single manufacturer.
    - b. Description: Flowmeter with sensor and indicator.
    - c. Flow Range: Sensor and indicator are to cover operating range of equipment or system served.
    - d. Sensor: Impeller turbine; for inserting in pipe fitting or for installing in piping and measuring flow directly in gpm.
      - 1) Design: Device or pipe fitting with inline turbine and integral direct-reading scale for gas oil steam water.
      - 2) Construction: Bronze or stainless steel body, with plastic turbine or impeller.
      - 3) Fitting for mounting probe in pipe, with weld or threaded connection for attachment to pipe. Provide way to permit removal of probe for service.
      - 4) Minimum Pressure Rating: 150 psig.
      - 5) Minimum Temperature Rating: 180 deg F.
    - e. Indicator: Handheld meter; either an integral part of sensor or a separate meter.
    - f. Accuracy: Plus or minus 1-1/2 percent.
    - g. Display: Shows rate of flow, with register to indicate total volume in gallons.
    - h. Operating Instructions: Include complete instructions with each flowmeter.
  5. Flowmeters - Venturi:
    - a. Source Limitations: Provide venture flowmeters from single manufacturer.
    - b. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
    - c. Flow Range: Sensor and indicator are to cover operating range of equipment or system served.
    - d. Flow-Measuring Element:
      - 1) Design: Differential-pressure-type measurement for gas oil steam water.
      - 2) Venturi type with in-line or insertion element.

- 3) Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
  - 4) Minimum Pressure Rating: 250 psig.
  - 5) Minimum Temperature Rating: 250 deg F.
  - 6) End Connections for NPS 2 (DN 50) and Smaller: Threaded.
  - 7) End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.
  - 8) Flow Range: Flow-measuring element and flowmeter are to cover operating range of equipment or system served.
  - e. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and has 6-inch-diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
    - 1) Scale: gpm.
    - 2) Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
  - f. Portable Indicators: Handheld, differential-pressure type, calibrated for connected flowmeter element and has two 12 ft. hoses, with carrying case.
    - 1) Scale: gpm.
    - 2) Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
  - g. Display: Shows rate of flow, with register to indicate total volume in gallons.
  - h. Conversion Chart: Flow rate data compatible with sensor.
  - i. Operating Instructions: Include complete instructions with each flowmeter.
6. Flowmeters - Vortex Shedding:
- a. Source Limitations: Provide vortex-shedding flowmeters from single manufacturer.
  - b. Description: Flowmeter with sensor and indicator.
  - c. Flow Range: Sensor and indicator are to cover operating range of equipment or system served.
  - d. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in gpm.
    - 1) Design: Flow-obstruction device, vortex-measurement type for gas steam and liquids.
    - 2) Construction: Stainless steel body, with integral transmitter and direct-reading scale.
    - 3) Minimum Pressure Rating: 1000 psig.
    - 4) Minimum Temperature Rating: 500 deg F.
    - 5) Integral Transformer: For low-voltage power operation.
  - e. Indicator: Handheld meter; either an integral part of sensor or a separate meter.
  - f. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
  - g. Display: Shows rate of flow, with register to indicate total volume in gallons.
  - h. Operating Instructions: Include complete instructions with each flowmeter.
7. Thermal-Energy Meters - Turbine:
- a. Source Limitations: Provide turbine thermal-energy meters from single manufacturer.
  - b. Performance Requirements: Manufacturer is to certify that each flowmeter complies with specified performance requirements and characteristics.
  - c. Description: System with strainer, flow sensor, two temperature sensors, transmitter, indicator, and connecting wiring.
  - d. Flow Sensor: Turbine type; for inserting in pipe fitting or for installing in piping and measuring flow directly in gpm.
    - 1) Design: Device or pipe fitting with inline turbine and integral direct-reading scale for gas oil steam water.
    - 2) Construction: Bronze or stainless steel body, with plastic turbine or impeller.
    - 3) Fitting for mounting probe in pipe, with weld or threaded connection for attachment to pipe. Provision to remove probe for service.
    - 4) Minimum Pressure Rating: 150 psig.
    - 5) Minimum Temperature Rating: 180 deg F.
  - e. Temperature Sensors: Insertion-type sensor-transducer.
  - f. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.
    - 1) Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
    - 2) Battery Pack: Five-year lithium battery.
  - g. Accuracy: Plus or minus 1 percent.
  - h. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.

- i. Strainer: Full size of main line piping.
- j. Operating Instructions: Include complete instructions with each thermal-energy meter system.
- 8. Thermal-Energy Meters - Ultrasonic:
  - a. Source Limitations: Provide ultrasonic thermal-energy meters from single manufacturer.
  - b. Performance Requirements: Manufacturer is to certify that each flowmeter complies with specified performance requirements and characteristics.
  - c. Description: Meter with flow sensor, two temperature sensors, transmitter, indicator, and connecting wiring.
  - d. Flow Sensor: Transit-time ultrasonic type with transmitter.
  - e. Temperature Sensors: Insertion-type or strap-on transducer.
  - f. Indicator: Solid-state, integrating-type meter with integral battery pack.
    - 1) Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
    - 2) Battery Pack: Five-year lithium battery.
  - g. Accuracy: Plus or minus 1 percent.
  - h. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
  - i. Operating Instructions: Include complete instructions with each thermal-energy meter system.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF EXPANSION JOINTS - GENERAL**

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

#### **3.2 INSTALLATION OF PACKED EXPANSION JOINTS**

- A. Install packed expansion joints with packing suitable for fluid service.

#### **3.3 INSTALLATION OF PACKLESS EXPANSION JOINTS**

- A. Install metal-bellows packless expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- B. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

#### **3.4 INSTALLATION OF GROOVED-JOINT EXPANSION JOINTS**

- A. Install grooved-joint expansion joints to grooved-end steel piping.

#### **3.5 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS**

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
  - 3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.6 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.7 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Retain subparagraph below if applicable.
  - 2. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.8 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

3.9 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.10 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.11 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

### 3.12 INSTALLATION OF METERS AND GAUGES

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing, and support tubing to prevent kinks. Use minimum tubing length.
- G. Install pipe-mounted thermal-energy temperature sensors in thermowells and extend wiring to indicator.
- H. Install duct-thermometer-mounting brackets in walls of ducts. Attach to duct with screws.
- I. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- J. Install remote-mounted pressure gauges on panel.
- K. Install valve and snubber in piping for each pressure gauge for fluids (except steam).
- L. Install valve and syphon fitting in piping for each pressure gauge for steam.
- M. Install test plugs in piping tees.
- N. Install flow indicators in piping systems in accessible positions for easy viewing.
- O. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- P. Install flowmeter elements in accessible positions in piping systems.
- Q. Install wafer-orifice flowmeter elements between orifice-type pipe flanges.
- R. Install all flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.
- S. Install permanent indicators on walls or brackets in accessible and readable positions.
- T. Install connection fittings in accessible locations for attachment to portable indicators.
- U. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- V. Install thermometers in the following locations:
  1. Inlet and outlet of each hydronic zone.
  2. Inlet and outlet of each hydronic boiler.
  3. Two inlets and two outlets of each chiller.
  4. Inlet and outlet of each hydronic coil in air-handling units.

5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

- W. Install pressure gauges in the following locations:
1. Discharge of each pressure-reducing valve.
  2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
  3. Suction and discharge of each pump.

### 3.13 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

### 3.14 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

### 3.15 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
  1. Perform the following tests and inspections:
    - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
    - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
  2. Prepare test and inspection reports.
- B. Escutcheons:
  1. Using new materials, replace broken and damaged escutcheons and floor plates.

### 3.16 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above and below Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  2. Concrete Slabs-on-Grade:
    - a. Sleeves with waterstops.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs above Grade:
    - a. Sleeves with waterstops or stack-sleeve fittings.
  4. Interior Walls and Partitions:
    - a. Sleeves without waterstops.

### 3.17 ESCUTCHEONS APPLICATION

- A. Escutcheons for New Piping and Relocated Existing Piping:
  1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  2. Chrome-Plated Piping: One piece, steel cast brass or split-plate steel with polished, chrome-plated finish.
  3. Insulated Piping:
    - a. One piece, steel with polished, chrome-plated polished brass finish.
    - b. One piece, stainless steel with polished stainless steel finish.
    - c. One piece, cast brass with polished, chrome-plated polished brass finish.
    - d. One piece, stamped steel or split plate, stamped steel with concealed hinge or split plate, stamped steel with exposed-ribose hinge with polished, chrome-plated finish.



4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
    - a. One piece, steel with polished, chrome-plated polished brass finish.
    - b. One piece, stainless steel with polished stainless steel finish.
    - c. One piece, cast brass with polished, chrome-plated polished brass finish.
    - d. One piece, stamped steel or split plate, stamped steel with concealed hinge or split plate, stamped steel with exposed-riquet hinge with polished, chrome-plated finish.
  5. Bare Piping at Ceiling Penetrations in Finished Spaces:
    - a. One piece, steel with polished, chrome-plated polished brass finish.
    - b. One piece, stainless steel with polished stainless steel finish.
    - c. One piece, cast brass with polished, chrome-plated polished brass finish.
    - d. One piece, stamped steel or split plate, stamped steel with concealed hinge or split plate, stamped steel with exposed-riquet hinge with polished, chrome-plated finish.
  6. Bare Piping in Unfinished Service Spaces:
    - a. One piece, steel with polished, chrome-plated finish.
    - b. One piece, cast brass with polished, chrome-plated rough-brass finish.
    - c. One piece, stamped steel or split plate, stamped steel with concealed hinge or split plate, stamped steel with exposed-riquet hinge with polished, chrome-plated finish.
  7. Bare Piping in Equipment Rooms:
    - a. One piece, steel with polished, chrome-plated finish.
    - b. One piece, cast brass with polished, chrome-plated rough-brass finish.
    - c. One piece, stamped steel or split plate, stamped steel with concealed hinge or split plate, stamped steel with exposed-riquet hinge with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
1. Chrome-Plated Piping: Split plate, stamped steel with concealed or exposed-riquet hinge with polished, chrome-plated finish.
  2. Insulated Piping: Split plate, stamped steel with concealed or exposed-riquet hinge with polished, chrome-plated finish.
  3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-riquet hinge with polished, chrome-plated finish.
  4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed or exposed-riquet hinge with polished, chrome-plated finish.
  5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed or exposed-riquet hinge with polished, chrome-plated finish.
  6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed or exposed-riquet hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping and Relocated Existing Piping: Split floor plate.
  2. Existing Piping to Remain: Split floor plate.
- 3.18 THERMOMETER APPLICATION
- A. Thermometers at inlet and outlet of each hydronic zone are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Compact-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- B. Thermometers at inlet and outlet of each hydronic boiler are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- C. Thermometers at inlets and outlets of each chiller are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.

4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- E. Thermometers at inlets and outlets of each hydronic heat exchanger are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- F. Thermometers at inlet and outlet of each hydronic heat-recovery unit are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- G. Thermometers at inlet and outlet of each thermal-storage tank are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
  5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- H. Thermometers at outside-, return-, supply-, and mixed-air ducts are to be the following:
1. Liquid-filled, bimetallic-actuated type.
  2. Direct-mounted, metal-case, vapor-actuated type.
  3. Industrial-style, liquid-in-glass type.
  4. Direct-mounted, light-activated type.
- I. Thermometer stems are to be of length to match thermowell insertion length.

### 3.19 THERMOMETER SCALE-RANGE APPLICATION

- A. Scale Range for Chilled-Water Piping:
1. Minus 40 to plus 160 deg F.
- B. Scale Range for Condenser-Water Piping:
1. 0 to 150 deg F.
- C. Scale Range for Heating, Hot-Water Piping:
1. 0 to 250 deg F.
- D. Scale Range for Steam and Steam-Condensate Piping:
1. 0 to 250 deg F.
- E. Scale Range for Air Ducts:
1. Minus 40 to plus 110 deg F.

### 3.20 PRESSURE-GAUGE APPLICATION

- A. Pressure gauges at discharge of each pressure-reducing valve are to be the following:
1. Liquid filled, direct mounted, metal case.
  2. Sealed, direct mounted, plastic case.
  3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- B. Pressure gauges at inlet and outlet of each chiller chilled-water and condenser-water connection are to be the following:
1. Liquid filled, direct mounted, metal case.
  2. Sealed, direct mounted, plastic case.
  3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

- C. Pressure gauges at suction and discharge of each pump are to be the following:
  - 1. Liquid-filled, direct mounted, metal case.
  - 2. Sealed, direct mounted, plastic case.
  - 3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

### 3.21 PRESSURE-GAUGE SCALE-RANGE APPLICATION

- A. Scale Range for Chilled-Water Piping:
  - 1. 30 in. Hg to 15 psi.
- B. Scale Range for Condenser-Water Piping:
  - 1. 30 in. Hg to 15 psi.
- C. Scale Range for Heating, Hot-Water Piping:
  - 1. 30 in. Hg to 15 psi.
- D. Scale Range for Steam Piping:
  - 1. 30 in. Hg to 15 psi.

### 3.22 FLOWMETER APPLICATION

- A. Flowmeters for Chilled-Water Piping: Orifice Pitot-tube Turbine Venturi Vortex-shedding type.
- B. Flowmeters for Condenser-Water Piping: Orifice Pitot-tube Turbine Venturi Vortex-shedding type.
- C. Flowmeters for Heating, Hot-Water Piping: Orifice Pitot-tube Turbine Venturi Vortex-shedding type.
- D. Flowmeters for Steam and Steam-Condensate Piping: Orifice Turbine Venturi Vortex-shedding type.

### 3.23 THERMAL-ENERGY METER APPLICATION

- A. Thermal-Energy Meters for Chilled-Water Piping: Turbine Ultrasonic type.
- B. Thermal-Energy Meters for Condenser-Water Piping: Turbine Ultrasonic type.
- C. Thermal-Energy Meters for Heating, Hot-Water Piping: Turbine Ultrasonic type.
- D. Thermal-Energy Meters for Steam and Steam-Condensate Piping: Turbine Ultrasonic type.

END OF SECTION 23 05 00

## SECTION 23 05 29

### HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe hangers and supports - metal.
  - 2. Pipe hangers - metal, trapeze type.
  - 3. Pipe hangers - FRP.
  - 4. Strut support systems - metal, rod type.
  - 5. Strut support systems - FRP.
  - 6. Strut support systems - rooftop mounted.
  - 7. Thermal-hanger shield inserts.
  - 8. Fastener systems.
  - 9. Equipment supports.
  - 10. Equipment stands - outdoor type.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Metal strut support systems.
  - 3. Rooftop-mounted strut support systems.
  - 4. FRP strut support systems.
  - 5. Pipe stands.
  - 6. Equipment supports.
- C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication/assembly and design calculations for trapeze hangers.
  - 2. Detail fabrication/assembly and design calculations for each type of strut support system, by the manufacturer's technical representative.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

##### 1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

- B. Structural Performance: Hangers and supports for HVAC piping and equipment are to withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

## 2.2 PIPE HANGERS AND SUPPORTS - METAL

- A. Pipe Hangers and Supports - Carbon Steel:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washers made of carbon steel.
- B. Pipe Hangers and Supports - Stainless Steel:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Pipe/Tube Hangers and Supports - Copper:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

## 2.3 PIPE HANGERS - METAL, TRAPEZE TYPE

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 PIPE HANGERS - FRP

- A. Pipe Hangers - FRP, Clevis Type:
  - 1. Description: Similar to MSS SP-58, Type 1, factory-fabricated steel pipe hanger except hanger is made of fiberglass-reinforced plastic resin.
  - 2. Hanger Rods: Continuous-thread stainless steel rod, washer, and nuts made of FRP polyurethane or stainless steel.
  - 3. Flammability: ASTM D635, ASTM E84, and UL 94.
- B. Pipe Hangers - FRP, Strap Type:
  - 1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger except hanger is made of fiberglass-reinforced plastic resin.
    - a. Flammability: ASTM D635, ASTM E84, and UL 94.
  - 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

## 2.5 STRUT SUPPORT SYSTEMS - METAL, ROD TYPE

- A. Description: Factory-fabricated pipe-support assembly made of steel channels, vertical metal support rods, accessories, fittings, and other components for supporting multiple parallel pipes.
- B. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
- C. Struts: Continuous slotted carbon-steel stainless steel, Type 304 stainless steel, Type 316 extruded-aluminum channel with inturred lips or angle.
- D. Strut Width: Selected for applicable load criteria.
- E. Strut Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- F. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
- G. Metallic Coating: Hot-dip galvanized.
- H. Paint Coating: Green epoxy, acrylic, or urethane.

- I. Plastic Coating: PVC.
- 2.6 STRUT SUPPORT SYSTEMS - FRP
- A. Description: Structural-grade, factory-formed, glass-fiber-resin channels and angles for supporting multiple parallel pipes.
    - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
    - 2. Struts: Continuous slotted fiberglass-reinforced plastic channel with inturned lips.
    - 3. Strut Width: Selected for applicable load criteria.
    - 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
    - 5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
    - 6. Rated Strength: Selected to suit applicable load criteria.
    - 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2.7 STRUT SUPPORT SYSTEMS - ROOFTOP MOUNTED
- A. General Requirements: Shop-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
  - B. Pipe Stand - Compact:
    - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
    - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
    - 3. Hardware: Galvanized steel or polycarbonate.
    - 4. Accessories: Protection pads.
  - C. Pipe Stand - Single Base, Single Pipe, Low Profile:
    - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
    - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
    - 3. Vertical Members: Two, stainless steel, continuous-thread 1/2-inch rods.
    - 4. Horizontal Member: Adjustable-height, stainless steel pipe support channels.
    - 5. Pipe Supports: Roller Strut clamps Clevis hanger Swivel hanger.
    - 6. Hardware: Stainless steel.
    - 7. Accessories: Protection pads.
    - 8. Height: 12 inches above roof.
  - D. Pipe Stand - Single Base, Single Pipe, High Profile:
    - 1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
    - 2. Base: Single vulcanized rubber or molded polypropylene.
    - 3. Vertical Members: Two, stainless steel, continuous-thread 1/2-inch rods.
    - 4. Horizontal Member: One, adjustable-height, galvanized-steel or stainless steel pipe support slotted channel or plate.
    - 5. Pipe Supports: Roller Clevis hanger Swivel hanger.
    - 6. Hardware: Stainless steel.
    - 7. Accessories: Protection pads, 1/2-inch continuous-thread stainless steel rod.
    - 8. Height: 36 inches above roof.
  - E. Pipe Stand - Multiple Pipe, High Profile:
    - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
    - 2. Bases: Two or more; vulcanized rubber molded polypropylene.
    - 3. Vertical Members: Two or more, stainless steel channels.
    - 4. Horizontal Members: One or more, adjustable-height, stainless steel pipe support.
    - 5. Pipe Supports: Roller Strut clamps Clevis hanger Swivel hanger.
    - 6. Hardware: Stainless steel.
    - 7. Accessories: Protection pads, 1/2-inch continuous-thread rod.
    - 8. Height: 36 inches above roof.
  - F. Pipe Stand - Curb-Mounted Type: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100 psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100 psi ASTM C552, Type II cellular glass with 100 psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125 psi minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield are to cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield are to cover bottom 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.9 FASTENER SYSTEMS

- A. Fastener System - Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities required for supported loads and building materials where used.
- B. Fastener System - Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities required for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc-plated or stainless steel.
  - 2. Outdoor Applications: Stainless steel.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 EQUIPMENT STANDS, OUTDOOR TYPE

- A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground- or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly-assembled on site.
- B. Foot Material: Rubber or polypropylene.
- C. Rails Material: Hot dip galvanized carbon steel.
- D. Wind/Sliding Load Resistance: Up to 100 mph minimum.

2.12 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000 psi, 28-day compressive strength.

**PART 3 - EXECUTION**

3.1 APPLICATION

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to include weight of supported components plus 200 lb.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install lateral bracing with pipe hangers and supports to prevent swaying.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Coordinate location of concrete inserts before concrete is placed.
- D. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- F. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
    - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- G. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- H. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate in accordance with ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel in accordance with AWS D1.1/D1.1M.
- I. FRP Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- J. Strut System Installation: FRP. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- K. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- L. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick after concrete is placed and cured. Use installers that are licensed by powder-actuated tool manufacturer.
  - 2. Install mechanical-expansion anchors after concrete is placed and completely cured.
  - 3. Install fasteners in accordance with manufacturer's written instructions.
  - 4. Install lag screw wood fasteners in accordance with manufacturer's written instructions.
- M. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.



2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 72 00 "Roof Accessories" for curbs.
  - N. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
  - O. Equipment Support Installation:
    1. Fabricate from welded-structural-steel shapes.
    2. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
    3. Grouting: Place grout under supports for floor-mounted equipment, and make bearing surface smooth.
    4. Provide lateral bracing, to prevent swaying.
- 3.3 METAL FABRICATIONS
- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
  - B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded.
  - C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
    1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    2. Obtain fusion without undercut or overlap.
    3. Remove welding flux immediately.
    4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
- 3.4 ADJUSTING
- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
  - B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- 3.5 PAINTING
- A. Touchup:
    1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
    2. Comply with requirements in Section 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting" and Section 09 96 00 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
    3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.
- 3.6 HANGER AND SUPPORT SCHEDULE
- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
  - B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
  - C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
  - D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
  - E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
  - F. Use stainless steel pipe hangers FRP pipe hangers and FRP strut systems and stainless steel or corrosion-resistant attachments for hostile environment applications.
  - G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
  - H. Use padded hangers for piping that is subject to scratching.

- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  - 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
  - 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
  - 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

## SECTION 23 05 53

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Warning tape.
  - 4. Pipe labels.
  - 5. Duct labels.
  - 6. Stencils.
  - 7. Valve tags.
  - 8. Warning tags.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  - 2. Letter and Background Color: As indicated for specific application under Part 3.
  - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 5. Fasteners: Stainless steel rivets or self-tapping screws.
  - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
  - 2. Letter and Background Color: As indicated for specific application under Part 3.
  - 3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 6. Fasteners: Stainless steel rivets or self-tapping screws.
  - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-taping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch.
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F.
- F. Minimum Width: 2 inches.

## 2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

## 2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.

- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
  - 1. Duct size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution ducts. Arrows may be either integral with label or may be applied separately.
  - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

## 2.6 STENCILS

- A. Stencils for Piping:
  - 1. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
  - 2. Stencil Material: Aluminum, brass, or fiberboard.
  - 3. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel acrylic enamel. Paint may be in pressurized spray-can form.
  - 5. Letter and Background Color: As indicated for specific application under Part 3.
- B. Stencils for Ducts:
  - 1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances of up to 15 ft. and proportionately larger lettering for greater viewing distances.
  - 2. Stencil Material: Fiberboard or metal.
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel acrylic enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel acrylic enamel. Paint may be in pressurized spray-can form.
  - 5. Letter and Background Color: Color as indicated for specific application under Part 3.
- C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  - 1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
  - 2. Stencil Material: Fiberboard or metal.
  - 3. Stencil Paint: Exterior, gloss, alkyd enamel acrylic enamel. Paint may be in pressurized spray-can form.
  - 4. Identification Paint: Exterior, alkyd enamel acrylic enamel. Paint may be in pressurized spray-can form.
  - 5. Letter and Background Color: As indicated for specific application under Part 3.

## 2.7 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.04-inch stainless steel, 0.024-inch aluminum, 0.031-inch oranodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wirelink chain orbeaded chain or S-hook.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Include valve-tag schedule in operation and maintenance data.

## 2.8 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Letter and Background Color: As indicated for specific application under Part 3.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

#### **3.2 INSTALLATION, GENERAL REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

#### **3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS**

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-blue background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

#### **3.4 INSTALLATION OF WARNING TAPE**

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

#### **3.5 INSTALLATION OF PIPE LABELS**

- A. Piping Color Coding: Painting of piping is specified in Section 09 91 23 "Interior Painting." Section 09 96 00 "High-Performance Coatings."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.
  - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- G. Pipe-Label Color Schedule:
  - 1. Chilled-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 2. Condenser-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  - 3. Heating Water Piping: White letters on an ANSI Z535.1 safety-green background.



4. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.
5. Low-Pressure Steam Piping: Black letters on an ANSI Z535.1 safety-yellow background.
6. High-Pressure Steam Piping: Black letters on an ANSI Z535.1 safety-yellow background.
7. Steam Condensate Piping: Black letters on an ANSI Z535.1 safety-yellow background.
8. Toxic and Corrosive Fluids: Black letters on an ANSI Z535.1 safety-orange background.
9. Flammable Fluids: Black letters on an ANSI Z535.1 safety-yellow background.
10. Combustible Fluids: White letters on an ANSI Z535.1 safety-brown background.
11. Potable and Other Water: White letters on an ANSI Z535.1 safety-green background.
12. Compressed Air: White letters on an ANSI Z535.1 safety-blue background.

### 3.6 INSTALLATION OF DUCT LABELS

- A. Install plastic-laminated duct labels showing service and flow direction with permanent adhesive on air ducts.
  1. Provide labels in the following color codes:
    - a. For air supply ducts: White letters on blue background.
    - b. For air return ducts: White letters on blue background.
    - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.
    - d.
- B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
  1. For all air ducts: Black letters on white background.
- C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.
- D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  1. Black letters on White background.

### 3.7 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
  1. Valve-Tag Size and Shape:
    - a. Chilled Water: 1-1/2 inches, round.
    - b. Condenser Water: 1-1/2 inches, round.
    - c. Refrigerant: 1-1/2 inches, round.
    - d. Hot Water: 1-1/2 inches, round.
    - e. Gas: 1-1/2 inches, round.
    - f. Low-Pressure Steam: 1-1/2 inches, round.
    - g. High-Pressure Steam: [1-1/2 inches], round.
    - h. Steam Condensate: 1-1/2 inches, round.
  2. Valve-Tag Colors:
    - a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

### 3.8 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where scheduled.

END OF SECTION 23 05 53

## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
  - a. Constant-volume air systems.
  - b. Dual-duct systems.
  - c. Variable-air-volume systems.
  - d. Multizone systems.
  - e. Induction-unit systems.
2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
  - a. Constant-flow hydronic systems.
  - b. Variable-flow hydronic systems.
  - c. Primary-secondary hydronic systems.
3. Testing, adjusting, and balancing of fuel oil systems for HVAC.
4. Testing, adjusting, and balancing of steam and condensate piping systems.
5. Testing, adjusting, and balancing of equipment.
6. Testing, adjusting, and balancing of existing HVAC systems and equipment.
7. Procedures for exhaust hoods.
8. Sound tests.
9. Vibration tests.
10. Duct leakage tests verification.
11. Pipe leakage tests verification.
12. UFAD plenum leakage tests verification.
13. HVAC-control system verification.
14. Smoke-control system tests.
15. Stair-pressurization system tests.
16. Elevator-pressurization system tests.

##### 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

##### 1.3 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
  1. Minimum Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Needs for coordination and cooperation of trades and subcontractors.
    - d. Proposed procedures for documentation and communication flow.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.

- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.
- L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.
  - 2. Hydronics:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
    - b. Piping is complete with terminals installed.

- c. Water treatment is complete.
- d. Systems are flushed, filled, and air purged.
- e. Strainers are pulled and cleaned.
- f. Control valves are functioning in accordance with the sequence of operation.
- g. Shutoff and balance valves have been verified to be 100 percent open.
- h. Pumps are started and proper rotation is verified.
- i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete and safeties are verified.
- k. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" ASHRAE 111 NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
  3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
  4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  1. Motors.
  2. Pumps.
  3. Fans and ventilators.
  4. Air curtains.
  5. Terminal units.
  6. Commercial kitchen hoods.
  7. Boilers.
  8. Deaerators.
  9. Furnaces.
  10. Radiant heaters.
  11. Unit heaters.
  12. Solar collectors.
  13. Heat exchangers.
  14. Condensing units.
  15. Condensers.
  16. Water chillers.
  17. Cooling towers.
  18. Energy-recovery units.
  19. Air-handling units.
  20. Heating and ventilating units.
  21. Rooftop air-conditioning units.
  22. Heating-only makeup air units.
  23. Dedicated outdoor-air units.
  24. Packaged air conditioners.
  25. Self-contained air conditioners.
  26. Computer-room air conditioners.

27. Split-system air conditioners.
28. Variable-refrigerant-flow systems.
29. Heat pumps.
30. Valance heating and cooling units.
31. Chilled beams.
32. Coils.
33. Fan coil units.
34. Unit ventilators.
35. Radiators.
36. Convectors.
37. Finned-tube radiation heaters.
38. Radiant-heating cables piping and panels.
39. Humidifiers.
40. Dehumidification units.

### 3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

### 3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
  - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  - 2. Measure inlets and outlets airflow.
  - 3. Adjust each inlet and outlet for specified airflow.
  - 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
  - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  - 2. Re-measure and confirm that total airflow is within design.
  - 3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
  - 4. Mark all final settings.
  - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  - 6. Measure and record all operating data.
  - 7. Record final fan-performance data.

### 3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Adjust the dual-duct systems as follows:
  - 1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge. On systems with separate hot-deck and cold-deck fans, verify the location of the sensor on each deck.
  - 2. Verify that the system is under static pressure control.
  - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point, so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 4. Calibrate and balance each terminal unit's hot deck and cold deck for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for full cooling. Some controllers require starting with minimum set point. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factors as required for design cold-deck maximum airflow and hot-deck minimum airflow. Record calibration factors.
    - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    - d. Adjust controls so that terminal is calling for full heating.
    - e. Measure airflow and adjust calibration factors as required for design cold-deck minimum airflow and hot-deck maximum airflow. Record calibration factors. If no minimum calibration is available, note any deviation from design airflow.
  - 5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Set terminals for maximum airflow. If system design includes diversity (cooling coil or fan), adjust terminals for maximum and minimum airflow so that connected total matches cooling coil or fan selection and simulates actual load in the building. In systems with separate hot-deck and cold-deck fans, diversity consideration applies to each individual fan.
    - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - 6. Measure the fan(s) static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan(s) while operating at maximum return airflow and minimum outdoor airflow.
  - a. Balance the return-air ducts and inlets.
  - b. Verify that all terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.
10. Record final fan-performance data.

### 3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
  2. Verify that the system is under static pressure control.
  3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
    - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    - d. Adjust controls so that terminal is calling for minimum airflow.
    - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
  5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
    - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  6. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report any artificial loading of filters at the time static pressures are measured.



7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  - a. Balance the return-air ducts and inlets.
  - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
  - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - b. Re-measure and confirm that total airflow is within design.
  - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
  - d. Mark final settings.
  - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
  - f. Verify tracking between supply and return fans.

### 3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.
- B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.
- C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.
- D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  1. Measure total airflow.
    - a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- E. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- F. Adjust air inlets and outlets for each space to indicated airflows.
  1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlet and outlet airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.

- G. Verify final system conditions.
  - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - 2. Re-measure and confirm that total airflow is within design.
  - 3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
  - 4. Mark all final settings.
  - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  - 6. Measure and record all operating data.
  - 7. Record final fan-performance data.

### 3.10 PROCEDURES FOR INDUCTION-UNIT SYSTEMS

- A. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser, to determine which risers must be throttled. Adjust risers to indicated airflow within specified tolerances.
- B. Adjust each induction unit.
- C. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- E. Balance airflow to each induction unit by measuring the nozzle pressure and comparing it to the manufacturer's published data for nozzle pressure versus cfm. Adjust the unit's inlet damper to achieve the required nozzle pressure for design cfm.
- F. Verify final system conditions.
  - 1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
  - 2. Re-measure and confirm that total airflow is within design.
  - 3. Re-measure all final fan operating data, speeds, volts, amps, and static profile.
  - 4. Mark all final settings.
  - 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  - 6. Measure and record all operating data.
  - 7. Record final fan-performance data.

3.11 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check highest vent for adequate pressure.
  - 3. Check flow-control valves for proper position.
  - 4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
  - 5. Verify that motor controllers are equipped with properly sized thermal protection.
  - 6. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
  - 1. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Adjust pumps to deliver total design flow.
  - 1. Measure total water flow.
    - a. Position valves for full flow through coils.
    - b. Measure flow by main flow meter, if installed.
    - c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
  - 2. Measure pump TDH as follows:
    - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    - c. Convert pressure to head and correct for differences in gauge heights.
    - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
    - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
  - 3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
  - 1. Measure flow in main and branch pipes.
  - 2. Adjust main and branch balance valves for design flow.
  - 3. Re-measure each main and branch after all have been adjusted.
- C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
  - 1. Measure flow at terminals.
  - 2. Adjust each terminal to design flow.
  - 3. Re-measure each terminal after it is adjusted.
  - 4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
  - 5. Perform temperature tests after flows have been balanced.
- D. For systems with pressure-independent valves at terminals:
  - 1. Measure differential pressure and verify that it is within manufacturer's specified range.
  - 2. Perform temperature tests after flows have been verified.
- E. For systems without pressure-independent valves or flow-measuring devices at terminals:
  - 1. Measure and balance coils by either coil pressure drop or temperature method.
  - 2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

- F. Verify final system conditions as follows:
  - 1. Re-measure and confirm that total water flow is within design.
  - 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
  - 3. Mark final settings.
- G. Verify that memory stops have been set.

### 3.13 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.
- B. Adjust the variable-flow hydronic system as follows:
  - 1. Verify that the pressure-differential sensor(s) is located as indicated.
  - 2. Determine whether there is diversity in the system.
- C. For systems with no flow diversity:
  - 1. Adjust pumps to deliver total design flow.
    - a. Measure total water flow.
      - 1) Position valves for full flow through coils.
      - 2) Measure flow by main flow meter, if installed.
      - 3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
    - b. Measure pump TDH as follows:
      - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      - 2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      - 3) Convert pressure to head and correct for differences in gauge heights.
      - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      - 5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
    - c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
  - 2. Adjust flow-measuring devices installed in mains and branches to design water flows.
    - a. Measure flow in main and branch pipes.
    - b. Adjust main and branch balance valves for design flow.
    - c. Re-measure each main and branch after all have been adjusted.
  - 3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
    - a. Measure flow at terminals.
    - b. Adjust each terminal to design flow.
    - c. Re-measure each terminal after it is adjusted.
    - d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    - e. Perform temperature tests after flows have been balanced.
  - 4. For systems with pressure-independent valves at terminals:
    - a. Measure differential pressure and verify that it is within manufacturer's specified range.
    - b. Perform temperature tests after flows have been verified.
  - 5. For systems without pressure-independent valves or flow-measuring devices at terminals:
    - a. Measure and balance coils by either coil pressure drop or temperature method.
    - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
  - 6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).
  - 7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
  - 8. Mark final settings and verify that all memory stops have been set.
  - 9. Verify final system conditions as follows:
    - a. Re-measure and confirm that total flow is within design.
    - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    - c. Mark final settings.

- D. For systems with flow diversity:
1. Determine diversity factor.
  2. Simulate system diversity by closing required number of control valves, as approved by Architect.
  3. Adjust pumps to deliver total design flow.
    - a. Measure total water flow.
      - 1) Position valves for full flow through coils.
      - 2) Measure flow by main flow meter, if installed.
      - 3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
    - b. Measure pump TDH as follows:
      - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      - 2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      - 3) Convert pressure to head and correct for differences in gauge heights.
      - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      - 5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
    - c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
  4. Adjust flow-measuring devices installed in mains and branches to design water flows.
    - a. Measure flow in main and branch pipes.
    - b. Adjust main and branch balance valves for design flow.
    - c. Re-measure each main and branch after all have been adjusted.
  5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
    - a. Measure flow at terminals.
    - b. Adjust each terminal to design flow.
    - c. Re-measure each terminal after it is adjusted.
    - d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    - e. Perform temperature tests after flows have been balanced.
  6. For systems with pressure-independent valves at terminals:
    - a. Measure differential pressure, and verify that it is within manufacturer's specified range.
    - b. Perform temperature tests after flows have been verified.
  7. For systems without pressure-independent valves or flow-measuring devices at terminals:
    - a. Measure and balance coils by either coil pressure drop or temperature method.
    - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
  8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
  9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
  10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
  11. Mark final settings and verify that memory stops have been set.
  12. Verify final system conditions as follows:
    - a. Re-measure and confirm that total water flow is within design.
    - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    - c. Mark final settings.
- 3.14 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS
- A. Balance the primary circuit flow first.
  - B. Balance the secondary circuits after the primary circuits are complete.
  - C. Adjust pumps to deliver total design flow.
    1. Measure total water flow.
      - a. Position valves for full flow through coils.
      - b. Measure flow by main flow meter, if installed.

- c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
    2. Measure pump TDH as follows:
      - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      - c. Convert pressure to head and correct for differences in gauge heights.
      - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      - e. With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
    3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
  - D. Adjust flow-measuring devices installed in mains and branches to design water flows.
    1. Measure flow in main and branch pipes.
    2. Adjust main and branch balance valves for design flow.
    3. Re-measure each main and branch after all have been adjusted.
  - E. Adjust flow-measuring devices installed at terminals for each space to design water flows.
    1. Measure flow at terminals.
    2. Adjust each terminal to design flow.
    3. Re-measure each terminal after it is adjusted.
    4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    5. Perform temperature tests after flows have been balanced.
  - F. For systems with pressure-independent valves at terminals:
    1. Measure differential pressure and verify that it is within manufacturer's specified range.
    2. Perform temperature tests after flows have been verified.
  - G. For systems without pressure-independent valves or flow-measuring devices at terminals:
    1. Measure and balance coils by either coil pressure drop or temperature method.
    2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
  - H. Verify final system conditions as follows:
    1. Re-measure and confirm that total water flow is within design.
    2. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    3. Mark final settings.
  - I. Verify that memory stops have been set.
- 3.15 PROCEDURES FOR STEAM AND CONDENSATE SYSTEMS
  - A. Measure and record upstream and downstream pressure of each piece of equipment.
  - B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
  - C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
  - D. Check settings and operation of each safety valve. Record settings.
  - E. Verify the operation of each steam trap.
- 3.16 PROCEDURES FOR STEAM-TO-WATER HEAT EXCHANGERS
  - A. Adjust and record water flow to within specified tolerances.
  - B. Measure and record inlet and outlet water temperatures.
  - C. Measure and record inlet steam pressure and condensate outlet pressure.
  - D. Check and record settings and operation of safety and relief valves.
- 3.17 PROCEDURES FOR WATER-TO-WATER HEAT EXCHANGERS
  - A. Adjust and record water flow to within specified tolerances.
  - B. Measure and record inlet and outlet water temperatures.

- C. Measure and record pressure drop.
- D. Check and record settings and operation of safety and relief valves.

### 3.18 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Phase and hertz.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter size and thermal-protection-element rating.
  - 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.19 PROCEDURES FOR WATER CHILLERS

- A. Air-Cooled Chillers: Balance water flow through each evaporator to within specified tolerances of indicated flow, with all pumps operating. With only one chiller operating in a multiple-chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
  - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
  - 2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
  - 3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
  - 4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
  - 5. Capacity: Calculate in tons of cooling.
  - 6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
  - 7. Verify condenser-fan rotation and record fan and motor data, including number of fans and entering- and leaving-air temperatures.
- B. Water-Cooled Chillers: Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow, with all pumps operating. With only one chiller operating in a multiple-chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
  - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
  - 2. Condenser-water entering and leaving temperatures, pressure drop, and water flow.
  - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
  - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
  - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
  - 6. Capacity: Calculate in tons of cooling.
  - 7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

### 3.20 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

### 3.21 PROCEDURES FOR AIR-COOLED CONDENSERS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of fan(s) and motor(s).

### 3.22 PROCEDURES FOR BOILERS

- A. Hydronic Boilers:
  - 1. Measure and record entering- and leaving-water temperatures.
  - 2. Measure and record water flow.
  - 3. Measure and record pressure drop.
  - 4. Measure and Record relief valve(s) pressure setting.
  - 5. Capacity: Calculate in Btu/h of heating output.
  - 6. Fuel Consumption: If boiler fuel supply is equipped with flow meter, measure and record consumption.
  - 7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
  - 8. Fan, motor, and motor controller operating data.
- B. Steam Boilers:
  - 1. Measure and record entering-water temperature.
  - 2. Measure and record feedwater flow.
  - 3. Measure and record leaving-steam pressure and temperature.
  - 4. Measure and Record relief valve(s) pressure setting.
  - 5. Capacity: Calculate in Btu/h of heating output.
  - 6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
  - 7. Fan, motor, and motor controller operating data.
- C. Boilers with Flue Gas Economizers:
  - 1. Measure and record entering- and leaving-water temperature.
  - 2. Measure and record water flow rate.
  - 3. Measure and record water pressure drop.
  - 4. Heat Recovered: Calculate in Btu/h of waste heat recovered.

### 3.23 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each hydronic coil:
  - 1. Entering- and leaving-water temperature.
  - 2. Water flow rate.
  - 3. Water pressure drop.
  - 4. Dry-bulb temperature of entering and leaving air.
  - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6. Airflow.
  - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Air pressure drop.
  - 5. Voltage and amperage input of each phase at full load.
  - 6. Calculated kilowatt at full load.
  - 7. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Airflow.
  - 3. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Wet-bulb temperature of entering and leaving air.
  - 3. Airflow.
  - 4. Air pressure drop.
  - 5. Entering and leaving refrigerant pressure and temperatures.

### 3.24 PROCEDURES FOR EXHAUST HOODS

- A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent space with hoods in room initially not operating and then with hoods operating.



- B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of exhaust hoods.
    - 1. Measure and record temperature of makeup air entering hood. If hood makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.
    - 2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of hoods. Consult with hood manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.
  - C. Rooms with Multiple Hoods: Test each hood separately, one at a time, and repeat tests with all hoods intended to operate simultaneously by design.
  - D. Canopy Hoods: Measure and record the following:
    - 1. Pressure drop across hood.
    - 2. Airflow by duct traverse where duct distribution will allow accurate measurement, and calculate hood average face velocity.
    - 3. Measure velocity across hood face and calculate hood airflow.
      - a. Clearly indicate the direction of flow at each point of measurement.
      - b. Measure velocity across opening on not less than 12-inch centers. Record velocity at each measurement, and calculate average velocity.
    - 4. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.
  - E. Laboratory Fume Hoods: Measure and record the following:
    - 1. Pressure drop across hood.
    - 2. Airflow by duct traverse where duct distribution will allow accurate measurement, and calculate hood average face velocity. If hood is connected to exhaust duct distribution through an exhaust device with integral airflow measurement, that reading may be used in lieu of a duct traverse.
    - 3. Face velocity across open hood face and calculate hood airflow.
      - a. Clearly indicate the direction of flow at each point of measurement.
      - b. Measure velocity across opening on not less than 6-inch centers. Record velocity at each measurement, and calculate average velocity.
    - 4. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.
    - 5. ASHRAE 110 Testing: With room and laboratory fume hood operating at design conditions, perform an "as-installed" performance test of the laboratory fume hood in accordance with ASHRAE 110. Test each laboratory fume hood and document the test results.
  - F. Kitchen Hoods:
    - 1. Type 1: Measure and record pressure drop and face velocity of hood filters and slots in accordance with hood manufacturer's instructions. Consult hood manufacturer to determine hood airflow using recorded information.
    - 2. Type 2: Measure and record airflow by duct traverse.
    - 3. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.
  - G. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.
- 3.25 SOUND TESTS
- A. After systems are balanced and Substantial Completion, measure and record sound levels at five locations as designated by the Architect.
  - B. Instrumentation:
    - 1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
    - 2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level ( $L_{eq}$ ).
    - 3. The sound-testing meter must be capable of using one-third octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
    - 4. The accuracy of the sound-testing meter shall be plus or minus one decibel.
  - C. Test Procedures:
    - 1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
    - 2. Equipment should be operating at design values.
    - 3. Calibrate the sound-testing meter prior to taking measurements.

4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight unweighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight unweighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:
  - a. Location.
  - b. System tested.
  - c. dBA reading.
  - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on Noise Criteria (NC) worksheet with equipment on and off.

3.26 VIBRATION TESTS

- A. After systems are balanced and Substantially Completion, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from AABC's "National Standards for Total System Balance." Acceptable levels of vibration are normally "smooth" to "good."
4. Include in General Machinery Vibration Severity Chart, with conditions plotted.

3.27 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.28 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.

- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### 3.29 UFAD PLENUM LEAKAGE TESTS

- A. Witness the UFAD plenum pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### 3.30 HVAC CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  - 1. Verify HVAC control system is operating within the design limitations.
  - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
  - 3. Verify that controllers are calibrated and function as intended.
  - 4. Verify that controller set points are as indicated.
  - 5. Verify the operation of lockout or interlock systems.
  - 6. Verify the operation of valve and damper actuators.
  - 7. Verify that controlled devices are properly installed and connected to correct controller.
  - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### 3.31 PROCEDURES FOR STAIR-PRESSURIZATION SYSTEMS

- A. Before testing, observe each pressurized stair enclosure to verify construction is complete. Verify the following:
  - 1. Walls and ceiling are free of unintended openings and are capable of achieving a pressure boundary.
  - 2. Firestopping and sealants are installed.
  - 3. Doors, door closers, and door gaskets are installed and adjusted.
  - 4. If applicable, window installation is complete.
  - 5. Stair-pressurization fans and associated controls are installed and functioning properly.
  - 6. Stair-pressurization duct distribution and air outlets are installed.
  - 7. Life-safety dampers (smoke or combination fire and smoke) are installed and functioning properly.
- B. Measure and record barometric pressure, wind speed and direction, outdoor-air temperature, and relative humidity on each test day.
- C. Test each stair enclosure as a single system. If multiple fans serve a single stair enclosure, operate fans as intended by the design.
- D. Initial Air Balance:
  - 1. Open doors to floors where indicated by design and measure, adjust, and record the airflow of each:
    - a. Stair-pressurization fan. For ducted systems, measure fan airflow by duct Pitot-tube traverse unless duct distribution does not permit accurate readings.
    - b. Air outlet supplying stair enclosure.
    - c. Adjust enclosure total airflow to achieve design pressurization.
    - d. Adjust method of stair enclosure pressure relief to prevent overpressurization.
- E. Pressurization Test and Adjustments:
  - 1. After air balancing is complete, perform stair enclosure pressurization tests.
  - 2. Establish a consistent procedure for recording data throughout entire test.
  - 3. Use stair side of doors as pressure reference point.
    - a. Positive Pressure: Floor side of door higher than stair side.
    - b. Negative Pressure: Floor side of door lower than stair side.
  - 4. With HVAC systems and stair-pressurization systems off, measure and record the following:
    - a. Pressure difference across each stair enclosure door, with all doors in the stair enclosure closed.
    - b. Force necessary to open each door, using a spring-type scale.

- c. Adjustment needed to achieve design pressurization of enclosure total airflow.
    - d. Adjustment needed to method of stair enclosure pressure relief, to prevent overpressurization.
  5. With HVAC systems operating in normal mode and stair-pressurization systems off, measure and record the following:
    - a. Pressure difference across each stair enclosure door, with all doors in the stair enclosure closed.
    - b. Force necessary to open each door, using a spring-type scale.
    - c. Adjustment needed to achieve design pressurization of enclosure total airflow.
    - d. Adjustment needed to method of stair enclosure pressure relief, to prevent overpressurization.
  6. With HVAC systems and stair-pressurization system operating simultaneously, perform the following:
    - a. Place HVAC systems in normal operating mode, including equipment not used to implement smoke control, such as air-handling units, exhaust fans, and similar equipment.
    - b. Measure and record pressure difference across each stair enclosure door, with all doors in stair enclosure closed.
    - c. Use a spring scale to measure and record the force needed to open all stair enclosure doors.
    - d. Adjust enclosure total airflow to achieve design pressurization.
    - e. Adjust method of stair enclosure pressure relief to prevent overpressurization.
    - f. Additional Tests for Designs with Open Doors:
      - 1) With exit door to outdoors in open position, measure and record pressure difference across each of the remaining closed stair enclosure doors.
      - 2) Open additional doors (up to the number indicated by design) one at a time, and measure and record pressure difference across each remaining closed stair enclosure door after the opening of each additional door.
      - 3) For each different test condition, measure and record the direction and velocity through each of the open doors by a traverse of every 1 sq. ft. grid of door opening.
      - 4) For each different test condition, calculate average of door velocity measurements. Compare average velocity to design and governing code requirements.
      - 5) Adjust enclosure total airflow to achieve design pressurization.
      - 6) Adjust method of stair enclosure pressure relief to prevent overpressurization.
  7. Repeat pressurization tests with the smoke-control systems and HVAC systems operating.
  8. Criteria for Acceptance:
    - a. Compliance with design requirements.
    - b. Compliance with code requirements.
    - c. Compliance with additional requirements required by authorities having jurisdiction.
- F. Operational Tests:
  1. Check proper activation of stair-pressurization system(s) in response to all means of activation, both automatic and manual.
  2. Verify that each initiating occurrence produces the proper system response under each of the following modes of operation:
    - a. Normal.
    - b. Alarm.
    - c. Manual override.
    - d. Return to normal.
  3. Verify smoke detector at pressurization fan de-energizes fan and closes isolation damper when smoke detector is activated and in alarm.
  4. If standby power is provided for pressurization systems, test to verify pressurization systems operate while on both normal and standby power.
  5. Check operation in accordance with design indicated.
- G. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.
- H. Report: Prepare and submit a complete report of observations, measurements, and deficiencies. Include names and contact information of individuals conducting tests and of individuals witnessing tests.

3.32 PROCEDURES FOR ELEVATOR-PRESSURIZATION SYSTEMS

- A. Before testing, observe each pressurized elevator enclosure to verify construction is complete. Verify the following:
  - 1. Walls and ceiling are free of unintended openings and are capable of achieving a pressure boundary.
  - 2. Firestopping and sealants are installed.
  - 3. Doors are installed and adjusted. Elevator car doors are recalled to the default recall floor, and elevator car doors on recall floor are open.
  - 4. If applicable, window installation is complete.
  - 5. Pressurization fans and associated controls are installed and functioning properly.
  - 6. Pressurization duct distribution and air outlets are installed.
  - 7. Life-safety dampers (smoke or combination fire and smoke) are installed and functioning properly.
- B. Measure and record barometric pressure, wind speed and direction, outdoor-air temperature, and relative humidity on each test day.
- C. Test each elevator enclosure as a single system. If multiple fans serve a single elevator enclosure, operate fans as intended by the design.
- D. Initial Air Balance:
  - 1. Open elevator car doors to recall floor indicated by design, and measure, adjust, and record the airflow of each:
    - a. Pressurization fan. For ducted systems, measure fan airflow by duct pitot-tube traverse unless duct distribution does not permit accurate readings.
    - b. Air outlet supplying elevator enclosure.
    - c. Adjustment needed to achieve design pressurization of enclosure total airflow.
    - d. Adjustment to method of elevator enclosure pressure relief, to prevent overpressurization.
- E. Pressurization Tests and Adjustments:
  - 1. After air balancing is complete, perform elevator enclosure pressurization tests.
  - 2. Establish a consistent procedure for recording data throughout entire test.
  - 3. Use elevator car side of doors as pressure reference point.
    - a. Positive Pressure: Floor side of door higher than elevator car side.
    - b. Negative Pressure: Floor side of door lower than elevator car side.
  - 4. With HVAC systems and elevator-pressurization systems off, measure and record the following:
    - a. Pressure difference across each elevator enclosure door with all doors in the elevator enclosure closed.
    - b. Adjustment needed to achieve design pressurization of enclosure total airflow.
    - c. Adjustment needed to method of stair enclosure pressure relief, to prevent overpressurization.
  - 5. With HVAC systems operating in normal mode and elevator pressurization systems off, measure and record the following:
    - a. Pressure difference across each elevator enclosure door with all doors in the elevator enclosure closed.
    - b. Adjustment needed to achieve design pressurization of enclosure total airflow.
    - c. Adjustment needed to method of stair enclosure pressure relief, to prevent overpressurization.
  - 6. With HVAC systems and elevator pressurization system operating simultaneously, perform the following:
    - a. Place HVAC systems in normal operating mode, including equipment not used to implement smoke control, such as air-handling units, exhaust fans, and similar equipment.
    - b. Measure and record pressure difference across each stair enclosure door, with all doors in stair enclosure closed.
    - c. Adjust enclosure total airflow to achieve design pressurization.
    - d. Adjust method of elevator enclosure pressure relief to prevent overpressurization.
  - 7. Repeat pressurization tests with smoke-control systems and HVAC systems operating.
  - 8. Criteria for Acceptance:
    - a. Compliance with design requirements.
    - b. Compliance with code requirements.
    - c. Compliance with additional requirements of authorities having jurisdiction.
- F. Operational Tests:
  - 1. Check proper activation of elevator-pressurization system(s) in response to all means of activation, both automatic and manual.

2. Verify that each initiating occurrence produces the proper system response under each of the following modes of operation:
    - a. Normal.
    - b. Alarm.
    - c. Manual override.
    - d. Return to normal.
  3. Verify smoke detector at pressurization fan de-energizes fan and closes isolation damper when smoke detector is activated and in alarm.
  4. If standby power is provided for pressurization systems, test to verify pressurization systems operate while on both normal and standby power.
  5. Check operation according to design indicated.
- G. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.
- H. Report: Prepare and submit a complete report of observations, measurements, and deficiencies. Include names and contact information of individuals conducting tests and of individuals witnessing tests.
- 3.33 PROCEDURES FOR SMOKE-CONTROL SYSTEM TESTING
- A. Before testing smoke-control systems, review design documents to understand operating requirements and design intent:
1. Review boundaries of each smoke zone.
  2. Review location, size, and operating characteristics of equipment, such as smoke and fire smoke dampers.
  3. Review sequence of operation, operating status of equipment, and position of smoke and fire dampers for each smoke zone alarm condition.
  4. Review location and type of alarm detection used to initiate smoke control for each smoke zone.
  5. Review other smoke-control system attributes not listed but required for code compliance and acceptance by authorities having jurisdiction.
- B. Before testing smoke-control systems, verify that construction is complete and verify the integrity of each smoke-control zone boundary.
1. Verify that windows, doors, walls, ceilings, and floors (six-sided boundary) are closed and that applicable safing, gasket, and firestops and sealants are installed.
  2. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- C. Measure and record barometric pressure, wind speed and direction, outdoor-air temperature, and relative humidity on each test day.
- D. Measure, adjust, and record airflow of each smoke-control system, with all fans that are a part of system operating as intended by the design.
1. Measure, adjust, and record the airflow of each fan. For ducted systems, measure fan airflow by duct Pitot-tube traverse.
  2. Measure, adjust, and record the airflow of each exhaust inlet and supply outlet.
  3. Measure, adjust, and record airflow in main and branch ducts.
- E. Smoke Control by Pressurization: After air balancing is complete, perform the following pressurization testing for each smoke-control zone in the system designed for isolation by using pressurization boundaries:
1. Verify the boundaries of each smoke-control zone.
  2. With the HVAC systems in their normal mode of operation and smoke control not operating, measure and record the pressure difference across each smoke-control zone. Make measurements after closing doors that separate the zones. Make one measurement across each door. Clearly indicate the high- and low-pressure side of each door.
  3. With the system operating in the smoke-control mode and with each separate zone in the smoke-control system activated, perform the following:
    - a. Measure and record the pressure difference across each door that separates the smoke zone from adjacent zones.
      - 1) Make measurements with doors that separate the smoke zone from the other zones closed.
      - 2) Clearly indicate the high- and low-pressure side of the door.
      - 3) Doors that have a tendency to open slightly due to the pressure difference should have one pressure measurement made while held closed and another measurement made with the door open.
    - b. Continue to activate each separate smoke zone within each smoke-control system, and make pressure-difference measurements.

- c. After testing a smoke zone's smoke-control system, deactivate the HVAC systems involved and return them to their normal operating mode before activating another zone's smoke-control system.
        - d. Verify that controls necessary to prevent excessive pressure differences are functional and operating within design set points and limits.
  - F. Smoke-Control Systems for Atriums and Other Large-Volume Spaces: After air balancing is complete, perform the following testing for each smoke-control system serving atriums and other large-volume spaces:
    1. Verify and document the boundaries served by each smoke-control system.
    2. Identify and document closed doors, open doors, and other boundary openings to be left open to adjacent areas and that are to be protected by airflow alone.
    3. With the HVAC systems in their normal mode of operation and smoke-control systems not operating, measure and record the following:
      - a. Pressure difference across each door that separates the smoke-zone from adjacent zones.
      - b. Velocity for each point in traverse across each boundary opening:
        - 1) Clearly indicate the direction of flow.
        - 2) Measure velocity across opening on 12-inch centers using a vane anemometer.
        - 3) Calculate and report airflow.
    4. With system operating in the smoke-control mode, measure and record the following:
      - a. Pressure difference across each door that separates the smoke-zone from adjacent zones.
      - b. Velocity for each point in traverse across each opening:
        - 1) Clearly indicate the direction of flow.
        - 2) Measure velocity across opening on 12-inch centers using a vane anemometer.
        - 3) Calculate and report airflow.
    5. Verify system operation and make adjustments to achieve design pressure differences and air velocities within design set points and upper operating limits.
  - G. Operational Tests:
    1. Check the proper activation of each zone of each smoke-control system in response to all means of activation, both automatic and manual.
    2. Check automatic activation in response to fire alarm signals received from the building's fire alarm system. Initiate a separate alarm for each means of activation to ensure that the proper operation of the correct zone of each smoke-control system occurs.
    3. Check and record proper operation of fans, dampers, and related equipment for each separate zone of each smoke-control system:
      - a. Zone in which a smoke-control system automatically activates.
      - b. Type of signal that activates smoke-control system, such as sprinkler flow or smoke detector.
      - c. Smoke zone(s) where maximum mechanical exhaust to the outside is implemented and no supply air is provided.
      - d. Positive-pressure smoke-control zone(s) where maximum air supply is implemented and no exhaust to the outside is provided.
      - e. Fan(s) "ON" as required to implement the smoke-control system. Multiple- or variable-speed fans should be further noted to verify that the intended control configuration is achieved.
      - f. Fan(s) "OFF" as required to implement the smoke-control system.
      - g. Damper(s) "OPEN" or at an adjustable position where maximum airflow must be achieved.
      - h. Damper(s) "CLOSED" where no airflow should take place.
      - i. Auxiliary functions to achieve the smoke-control system configuration, such as changes or override of normal operating pressure and temperature-control set points.
      - j. If standby power is provided for the smoke-control system, test to verify that the system functions while operating under both normal and standby power.
      - k. Check operation in accordance with design indicated.
  - H. AHJ Tests: Conduct additional tests required by authorities having jurisdiction. Unless required by authorities having jurisdiction, perform testing without the use of smoke or products that simulate smoke.
  - I. Report: Prepare and submit a complete report of observations, measurements, and deficiencies. Include names and contact information of individuals conducting tests and of individuals witnessing tests.
- 3.34 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS
- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
    1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).

2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
  3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  4. Check the refrigerant charge.
  5. Check the condition of filters.
  6. Check the condition of coils.
  7. Check the operation of the drain pan and condensate-drain trap.
  8. Check bearings and other lubricated parts for proper lubrication.
  9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
1. New filters are installed.
  2. Coils are clean and fins combed.
  3. Drain pans are clean.
  4. Fans are clean.
  5. Bearings and other parts are properly lubricated.
  6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.
- 3.35 TOLERANCES
- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
  2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
  3. Heating-Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
  4. Chilled-Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
  5. Condenser-Water Flow Rate: Plus or minus 5 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.
- 3.36 PROGRESS REPORTING
- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.
- 3.37 FINAL REPORT
- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.



2. Include a list of instruments used for procedures, along with proof of calibration.
  3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB specialist.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans performance forms, including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Heating coil, dry-bulb conditions.
    - e. Face and bypass damper settings at coils.
    - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    - g. Variable-frequency controller settings for variable-air-volume systems.
    - h. Settings for pressure controller(s).
    - i. Other system operating conditions that affect performance.
  16. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).
    - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.

- h. Sheave make, size in inches, and bore.
      - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
      - j. Number, make, and size of belts.
      - k. Number, type, and size of filters.
    - 2. Motor Data:
      - a. Motor make, and frame type and size.
      - b. Horsepower and speed.
      - c. Volts, phase, and hertz.
      - d. Full-load amperage and service factor.
      - e. Sheave make, size in inches, and bore.
      - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - 3. Test Data (Indicated and Actual Values):
      - a. Total airflow rate in cfm.
      - b. Total system static pressure in inches wg.
      - c. Fan speed.
      - d. Inlet and discharge static pressure in inches wg.
      - e. For each filter bank, filter static-pressure differential in inches wg.
      - f. Preheat-coil static-pressure differential in inches wg.
      - g. Cooling-coil static-pressure differential in inches wg.
      - h. Heating-coil static-pressure differential in inches wg.
      - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
      - j. Outdoor airflow in cfm.
      - k. Return airflow in cfm.
      - l. Outdoor-air damper position.
      - m. Return-air damper position.
      - n. Vortex damper position.
- F. Apparatus-Coil Test Reports:
  - 1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft..
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    - e. Return-air, wet- and dry-bulb temperatures in deg F.
    - f. Entering-air, wet- and dry-bulb temperatures in deg F.
    - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    - h. Water flow rate in gpm.
    - i. Water pressure differential in feet of head or psig.
    - j. Entering-water temperature in deg F.
    - k. Leaving-water temperature in deg F.
    - l. Refrigerant expansion valve and refrigerant types.
    - m. Refrigerant suction pressure in psig.
    - n. Refrigerant suction temperature in deg F.
    - o. Inlet steam pressure in psig.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
  - 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.

- d. Model number and unit size.
  - e. Manufacturer's serial number.
  - f. Fuel type in input data.
  - g. Output capacity in Btu/h.
  - h. Ignition type.
  - i. Burner-control types.
  - j. Motor horsepower and speed.
  - k. Motor volts, phase, and hertz.
  - l. Motor full-load amperage and service factor.
  - m. Sheave make, size in inches, and bore.
  - n. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
  - b. Entering-air temperature in deg F.
  - c. Leaving-air temperature in deg F.
  - d. Air temperature differential in deg F.
  - e. Entering-air static pressure in inches wg.
  - f. Leaving-air static pressure in inches wg.
  - g. Air static-pressure differential in inches wg.
  - h. Low-fire fuel input in Btu/h.
  - i. High-fire fuel input in Btu/h.
  - j. Manifold pressure in psig.
  - k. High-temperature-limit setting in deg F.
  - l. Operating set point in Btu/h.
  - m. Motor voltage at each connection.
  - n. Motor amperage for each phase.
  - o. Heating value of fuel in Btu/h.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
- a. System identification.
  - b. Location.
  - c. Coil identification.
  - d. Capacity in Btu/h.
  - e. Number of stages.
  - f. Connected volts, phase, and hertz.
  - g. Rated amperage.
  - h. Airflow rate in cfm.
  - i. Face area in sq. ft..
  - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
- a. Heat output in Btu/h.
  - b. Airflow rate in cfm.
  - c. Air velocity in fpm.
  - d. Entering-air temperature in deg F.
  - e. Leaving-air temperature in deg F.
  - f. Voltage at each connection.
  - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
- a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
- a. Motor make, and frame type and size.
  - b. Horsepower and speed.

- c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan speed.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  - 1. Report Data:
    - a. System fan and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
  - 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
  - 1. Unit Data:
    - a. System and air-handling-unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.

- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig.
    - h. Required net positive suction head in feet of head or psig.
    - i. Pump speed.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.
  2. Test Data (Indicated and Actual Values):
    - a. Static head in feet of head or psig.
    - b. Pump shutoff pressure in feet of head or psig.
    - c. Actual impeller size in inches.
    - d. Full-open flow rate in gpm.
    - e. Full-open pressure in feet of head or psig.
    - f. Final discharge pressure in feet of head or psig.
    - g. Final suction pressure in feet of head or psig.
    - h. Final total pressure in feet of head or psig.
    - i. Final water flow rate in gpm.
    - j. Voltage at each connection.
    - k. Amperage for each phase.
- N. Instrument Calibration Reports:
1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.38 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.
- B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.39 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

## SECTION 23 07 13

### DUCT INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
  - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
  - 7. Indoor, concealed oven and warewash exhaust.
  - 8. Indoor, exposed oven and warewash exhaust.
  - 9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 11. Outdoor, concealed supply and return.
  - 12. Outdoor, exposed supply and return.
- B. Related Requirements:
  - 1. Section 23 07 16 "HVAC Equipment Insulation."
  - 2. Section 23 07 19 "HVAC Piping Insulation."
  - 3. Section 23 31 13 "Metal Ducts" for duct liners.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Sheet Form Insulation Materials: 12 inches square.
  - 2. Sheet Jacket Materials: 12 inches square.
  - 3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program, certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
    - 1. Ductwork Mockups:
      - a. One 10-foot section each of rectangular and round straight duct.
      - b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
      - c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
      - d. One rectangular and round transition fitting.
      - e. Four support hangers for round and rectangular ductwork.
      - f. Each type of damper and specialty.
    - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
    - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
    - 4. Obtain Architect's approval of mockups before starting insulation application.
    - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
    - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    - 7. Demolish and remove mockups when directed.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.
- 1.6 COORDINATION
- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
  - B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
  - C. Coordinate installation and testing of heat tracing.
- 1.7 SCHEDULING
- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

### **2.2 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.



- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534, Type II for sheet materials.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
- G. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Manson Insulation Inc.
    - c. Owens Corning.
- H. High-Temperature, Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1000 deg F. Comply with ASTM C553, Type V.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Manson Insulation Inc.
    - c. Owens Corning.
- I. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Owens Corning.
    - c. ROCKWOOL.
- J. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Manson Insulation Inc.
    - c. Owens Corning.
- K. High-Temperature, Glass-Fiber Board: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Manson Insulation Inc.
    - c. Owens Corning.
- L. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Owens Corning.
    - c. ROCKWOOL.
- M. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Manson Insulation Inc.

- c. Owens Corning.
    - 2. Semirigid board material with factory-applied ASJ jacket.
    - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - N. Mineral Wool, Pipe and Tank: Mineral wool fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1000 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Johns Manville; a Berkshire Hathaway company.
      - b. Owens Corning.
      - c. ROCKWOOL.
    - 2. Semirigid board material with factory-applied ASJ jacket.
    - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - O. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Armacell LLC.
      - b. Sekisui Voltek, LLC.
      - c. Thermafact.
- 2.3 FIRE-RATED INSULATION SYSTEMS
- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Johns Manville; a Berkshire Hathaway company.
  - B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. 3M.
      - b. 3M Building and Construction.
      - c. CertainTeed; SAINT-GOBAIN.
- 2.4 ADHESIVES
- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
  - B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Aeroflex USA.
      - b. Armacell LLC.
      - c. K-Flex USA.
  - C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Childers Brand; H. B. Fuller Construction Products.
      - b. Eagle Bridges - Marathon Industries.
      - c. Foster Brand; H. B. Fuller.
  - D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Childers Brand; H. B. Fuller Construction Products.
      - b. Eagle Bridges - Marathon Industries.
      - c. Foster Brand; H. B. Fuller.
  - E. PVC Jacket Adhesive: Compatible with PVC jacket.
    - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. Dow Consumer Solutions.
      - b. Johns Manville; a Berkshire Hathaway company.
      - c. P.I.C. Plastics, Inc.

## 2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Childers Brand; H. B. Fuller Construction Products.
    - c. Foster Brand; H. B. Fuller.
  - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
  - 5. Color: Black.
- C. Vapor-Retarder Mastic, Solvent Based, Interior Use: Suitable for indoor use on below ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller.
  - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 3. Service Temperature Range: 0 to 180 deg F.
  - 4. Color: Black.
- D. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Childers Brand; H. B. Fuller Construction Products.
    - c. Eagle Bridges - Marathon Industries.
  - 2. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
  - 4. Color: Black.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller.
  - 2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Color: Black.

## 2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller.
    - c. Vimasco Corporation.
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 3. Service Temperature Range: 0 to plus 180 deg F.
  - 4. Color: White.

## 2.7 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Eagle Bridges - Marathon Industries.
    - c. Foster Brand; H. B. Fuller.

2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller.
2. Materials are compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: Black.
- D. Metal Jacket:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. RPR Products, Inc.
  2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  3. Stainless Steel Jacket: ASTM A240/A240M.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Material, finish, and thickness are indicated in field-applied jacket schedules.

- c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
      - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a. Foster Brand; H. B. Fuller.
        - b. MFM Building Products Corp.
        - c. Polyguard Products, Inc.
    - F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
      - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a. 3M.
        - b. Foster Brand; H. B. Fuller.
        - c. Ideal Tape Co., Inc., an American Biltrite Company.
      - 2. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
      - 3. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
      - 4. Aluminum Finish: Embossed.
- 2.10 FIELD-APPLIED FABRIC-REINFORCING MESH
- A. Woven Glass-Fiber Mesh: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Childers Brand; H. B. Fuller Construction Products.
      - b. Foster Brand; H. B. Fuller.
  - B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Childers Brand; H. B. Fuller Construction Products.
      - b. Foster Brand; H. B. Fuller.
      - c. Vimasco Corporation.
- 2.11 FIELD-APPLIED CLOTHS
- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
    - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      - a. Alpha Associates, Inc.
- 2.12 TAPES
- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. 3M Industrial Adhesives and Tapes Division.
      - b. Aeroflex USA.
      - c. Avery Dennison Corporation, Specialty Tapes Division.
    - 2. Width: 3 inches.
    - 3. Thickness: 11.5 mils.
    - 4. Adhesion: 90 ounces force/inch in width.
    - 5. Elongation: 2 percent.
    - 6. Tensile Strength: 40 lbf/inch in width.
    - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
  - B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. 3M Industrial Adhesives and Tapes Division.

- b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - 2. Width: 3 inches.
  - 3. Thickness: 6.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
  - 2. Width: 2 inches.
  - 3. Thickness: 3.7 mils.
  - 4. Adhesion: 100 ounces force/inch in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch in width.

## 2.13 SECUREMENTS

- A. Bands:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. RPR Products, Inc.
  - 2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
  - 3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
  - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
  - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Midwest Fasteners, Inc.
  - 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) CL WARD & Family Inc.
      - 3) Midwest Fasteners, Inc.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Midwest Fasteners, Inc.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Gemco.
      - 2) Midwest Fasteners, Inc.
    - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Midwest Fasteners, Inc.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive-backed base with a peel-off protective cover.
  6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) AGM Industries, Inc.
      - 2) Gemco.
      - 3) Midwest Fasteners, Inc.
    - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Gemco.
      - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire Products.
    - b. Johns Manville; a Berkshire Hathaway company.

c. RPR Products, Inc.

2.14 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC in accordance with ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel in accordance with ASTM A240/A240M, Type 304 or Type 316.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.



3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- 3.4 PENETRATIONS
- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION
- A. Comply with manufacturer's written installation instructions and ASTM C1710.
- B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Square and Rectangular Ducts and Plenums:
1. Provide 1/4 inch more per side for a tight, compression fit.
  2. Cut sheet insulation with the following dimensions:
    - a. Width of duct plus 1/4 inch, one piece.
    - b. Height of duct plus 1/4 inch, plus thickness of insulation, two pieces.
    - c. Width of duct plus 1/4 inch, plus two times the thickness of insulation, one piece.
  3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
  4. Insulation without self-adhering backing:
    - a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch where sheets will butt together.

- b. Roll sheet down into position.
      - c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.
    5. Insulation with self-adhering backing:
      - a. Peel back release paper in 6- to 8-inch increments and line up sheet.
      - b. Press firmly to activate adhesive.
      - c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
      - d. Allow 1/4-inch overlap for compression at butt joints.
      - e. Apply adhesive at the butt joint to seal the two sheets together.
    6. Insulate duct brackets following manufacturer's written installation instructions.
  - D. Circular Ducts:
    1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
    2. Cut the sheet to the required size.
    3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
    4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.
- 3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION
  - A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - B. Comply with manufacturer's written installation instructions.
    1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
    2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
    3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      - d. Do not overcompress insulation during installation.
      - e. Impale insulation over pins and attach speed washers.
      - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
    4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
      - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
      - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
    5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
    6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
    7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
  - C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
    1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
    2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- C. Insulate duct access panels and doors to achieve same fire rating as duct.
- D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 07 84 13 "Penetration Firestopping."

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
  - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
  - 7. Indoor, concealed oven and warewash exhaust.
  - 8. Indoor, exposed oven and warewash exhaust.
  - 9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 11. Outdoor, concealed supply and return.
  - 12. Outdoor, exposed supply and return.
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation is one of the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - 4. Polyolefin: 1 inch thick.
- B. Concealed, round and flat-oval, return-air duct insulation is one of the following:
  - 1. Flexible Elastomeric: 1 inch thick.
  - 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.

4. Polyolefin: 1 inch thick.
- C. Concealed, round and flat-oval, outdoor-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  4. Polyolefin: 1 inch thick.
- D. Concealed, round and flat-oval, exhaust-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  4. Polyolefin: 1 inch thick.
- E. Concealed, rectangular, supply-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- F. Concealed, rectangular, return-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- G. Concealed, rectangular, outdoor-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.
- J. Concealed, supply-air plenum insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- K. Concealed, return-air plenum insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- L. Concealed, outdoor-air plenum insulation is one of the following:
1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.

2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
- M. Concealed, exhaust-air plenum insulation is one of the following:
1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
- N. Exposed, round and flat-oval, supply-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- O. Exposed, round and flat-oval, return-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- P. Exposed, round and flat-oval, outdoor-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- Q. Exposed, round and flat-oval, exhaust-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- R. Exposed, rectangular, supply-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- S. Exposed, rectangular, return-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.
- T. Exposed, rectangular, outdoor-air duct insulation is one of the following:
1. Flexible Elastomeric: 1 inch thick.
  2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
  3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
  4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  6. Polyolefin: 1 inch thick.

- U. Exposed, rectangular, exhaust-air duct insulation is one of the following:
    - 1. Flexible Elastomeric: 1 inch thick.
    - 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 6. Polyolefin: 1 inch thick.
  - V. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.
  - W. Exposed, supply-air plenum insulation is one of the following:
    - 1. Flexible Elastomeric: 1 inch thick.
    - 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 6. Polyolefin: 1 inch thick.
  - X. Exposed, return-air plenum insulation is one of the following:
    - 1. Flexible Elastomeric: 1 inch thick.
    - 2. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 3. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 4. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 5. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 6. Polyolefin: 1 inch thick.
  - Y. Exposed, outdoor-air plenum insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - Z. Exposed, exhaust-air plenum insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
- 3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE
- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
  - B. Concealed, round and flat-oval, supply-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 2 inches and 0.75 lb/cu. ft. nominal density.
    - 2. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - C. Concealed, round and flat-oval, return-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 2 inches and 0.75 lb/cu. ft. nominal density.
    - 2. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - D. Concealed, round and flat-oval, outdoor-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 2 inches and 0.75 lb/cu. ft. nominal density.
    - 2. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - E. Concealed, rectangular, supply-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - F. Concealed, rectangular, return-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.

- G. Concealed, supply-air plenum insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - H. Concealed, return-air plenum insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - I. Exposed, round and flat-oval, supply-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - J. Exposed, round and flat-oval, return-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - K. Exposed, rectangular, supply-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - L. Exposed, rectangular, return-air duct insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - M. Exposed, supply-air plenum insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
  - N. Exposed, return-air plenum insulation is one of the following:
    - 1. Glass-Fiber Blanket: 1-1/2 inches thick and 0.75 lb/cu. ft. nominal density.
    - 2. Glass-Fiber Board: 1-1/2 inches thick and 2 lb/cu. ft. nominal density.
    - 3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
    - 4. Mineral Wool Board: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
- 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
  - B. If more than one material is listed, selection from materials listed is Contractor's option.
  - C. Ducts and Plenums, Concealed:
    - 1. None.
    - 2. PVC: 20 mils thick.
    - 3. Aluminum, Corrugated: 0.016 inch thick.
    - 4. Painted Aluminum, Corrugated: 0.016 inch thick.
    - 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated: 0.016 inch thick.
    - 6. ASJ.
  - D. Ducts and Plenums, Exposed:
    - 1. None.
    - 2. PVC: 20 mils thick.
    - 3. Aluminum, Corrugated: 0.016 inch thick.
    - 4. Painted Aluminum, Corrugated: 0.016 inch thick.



5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated: 0.016 inch thick.
6. ASJ.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  1. None.
  2. PVC: 20 mils thick.
  3. Aluminum, Corrugated: 0.016 inch thick.
  4. Painted Aluminum, Corrugated: 0.016 inch thick.
  5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated: 0.016 inch thick.
  6. ASJ.
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  1. None.
  2. PVC: 20 mils thick.
  3. Aluminum, Corrugated: 0.016 inch thick.
  4. Painted Aluminum, Corrugated: 0.016 inch thick.
  5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated: 0.016 inch thick.
  6. ASJ.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
  1. None.
  2. PVC: 20 mils thick.
  3. Aluminum, Corrugated: 0.016 inch thick.
  4. Painted Aluminum, Corrugated: 0.016 inch thick.
  5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated: 0.016 inch thick.
  6. ASJ.

END OF SECTION 23 07 13

## SECTION 23 09 23

### ENERGY MANAGEMENT CONTROL SYSTEM (BACNET)

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. It is the intent of this specification to describe the basic architecture and performance requirements of the Energy Management Control System (EMCS). The turn-key EMCS shall include Control Units, Distributed Controllers, Unitary Controllers, Local Area Networks (LANs), sensors, modems, wiring, connectors, control devices, actuators, installation and calibration, supervision, adjustments, and fine tuning necessary for a complete and fully operational system.
- B. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2001, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using Native BACnet-compliant components.
- C. All systems shall be complete true stand-alone systems.
- D. LonWorks or proprietary protocol software is not allowed.
- E. Everything shall be reprogrammed through software without change of any hardware. The owner shall have all the tools necessary to reprogram without any additional costs.
- F. EMCS shall have backward and forward compatibility.
- G. Systems shall be furnished and installed complete in all respects, including any and all equipment, controls, wiring, instrumentation, enclosures, labor, engineering, training, commissioning, programming, supervision, calibration, coordination with other trades, etc. No information given in (or omitted from) these specifications shall relieve the contractor of this absolute requirement. Include all associated electrical work except as noted. Work includes furnishing of all labor, superintendence, materials, tools, equipment and sources necessary for the complete installation or modification of the following systems as herein specified. It is the intent of these specifications that the Contractor shall furnish and install the systems complete in every respect and ready to operate. All equipment, miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed.
- H. Bidders shall take into account that projects require verification of existing conditions that are not described in these specifications. Bids shall include, at Bidder's discretion, costs related to site verifications for renovation projects. No additional costs shall be allowed for such items.
- I. Should discrepancies or ambiguities arise within these specifications, the most stringent condition with regard to cost shall govern the bid. Obtain clarification from the Engineer prior to purchasing equipment and proceeding with the work.
- J. Where drawings are provided as part of or supplement to these specifications, such drawings are inherently schematic only and not intended to convey all controls, wiring, installation, details, etc. It shall be the responsibility of the EMCS contractor to verify that control approaches presented are appropriate for the HVAC systems involved, and that bids include all work described, specified, or otherwise necessary for a complete and functioning system.
- K. Schedule: Contractor acknowledges that submission of bid constitutes agreement with and conformance to the completion dates.
- L. Codes, Permits, and Fees: This contractor shall comply with all local, state and national codes, and shall secure and pay all applicable costs, fees, permits, and licenses. No additional costs shall be allowed for these items.

- M. Other Conditions:
1. Safety: Execute all work with the highest regard to safety. Comply with all laws governing safety, including the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", State and federal. All applicable power tools used during construction shall have current approval under an approved Equipment Grounding Program, and shall bear the tag relating such. Contractor is solely responsible for all means and methods.
  2. Coordination and Supervision: Each bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Contractor shall keep competent supervisory personnel on the job whenever work is being performed which affects his trade.
  3. Storage of Materials: Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be weatherproof and lockable as required.
  4. Protection of Building and Materials: Each Contractor shall take necessary precautions to prevent damage to existing buildings and to work of other trades.
  5. Observations: Site observation by Owner or Engineer is for express purpose of verifying compliance by Contractor with Contract Documents, and shall not be construed as construction supervision nor indication of approval of manner or location in which work is being performed as being safe practice or place.
  6. Contractor is reminded that he shall also comply with all respects to the Invitation to Bid, General Conditions, Supplementary Conditions, Notice of Bidders, Instructions to Bidders, and all other governing parts of these specifications and the contract documents. These sections are included as part of the contract.
  7. Where the term "Contractor" is used within these specifications, it shall be understood to mean an approved controls manufacturer/contractor, and facility management systems contractor.
- N. The entire system shall be approved and listed by Underwriters Laboratories, Inc., under UL 916 for energy management systems and FCC-Part 15 Subparagraph J Class A Emissions Requirements.
- O. Equipment and Software Updates/Upgrades:
1. Equipment: All equipment, components, parts, materials, etc. provided throughout the period of Work (as governed in the Agreement) shall be fully compatible with all other equipment, etc. provided at any other time throughout the period of Work. Should updated versions of equipment be provided which are not fully compatible with earlier equipment provided, Contractor shall replace earlier equipment with the later version at no cost to Owner.
  2. Software: All software upgrades applicable to system and offered by the manufacturer/contractor for this system shall be provided at no cost to the Owner throughout the period of work. This no cost upgrade shall include installation, programming, modifications to field equipment, data base revisions, training, etc. as appropriate.
- P. The Engineer shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications.
- 1.2 WORK INCLUDED
- A. Existing control system is Alerton controls by Climatec. All new equipment to be connected to the existing EMCS. All programming, software upgrades, controllers, etc. necessary to connect new equipment to existing control system shall be verified and provided by Climatec.
  - B. The EMCS shall be a totally Native BACnet-based system based on a distributed control system in accordance with this specification. The workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2001, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be Native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
  - C. The installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS Web server) for the new software platform to function in a peer-to-peer environment.
  - D. The owner will provide reserved DHCP addresses and any other network configuration information necessary to each control contractor for the purpose of configuring each building controller and/or server on the owner's network. The controls contractor shall coordinate the IP address for each building controller and/or server. It shall be the responsibility of each control contractor to coordinate with the owner for network connectivity.

- E. The Energy Management and Control System (EMCS) application program shall be written to communicate specifically utilizing BACnet protocols. Software shall include password protection, alarming, logging of historical data, full graphics including animation, full suite of field engineering tools including graphical programming and applications. Systems using operating systems other than that described above are strictly prohibited.
- F. Building controllers shall include complete energy management software, including scheduling building control strategies and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the operator's terminal. Operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- G. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.
- H. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- I. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- J. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- K. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- L. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- M. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- N. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- O. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
- P. Provide a comprehensive operator and technician training program as described herein.
- Q. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- R. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.
- S. Unless otherwise specified, all products shall be of single manufacturer where possible with substitutions approved by Engineer/Owner.
- T. Provide all indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified and to operate other items specified.
- U. Provide protective devices to prevent damage to the EMCS as a result of lightning.
- V. The Energy Management Control system shall allow full user operation with minimum of training. It shall have an English language display, with both user prompts and a "help" user tutorial. It shall contain management reports for the monitoring of both current and historical energy usage, heating and cooling degree day, building status and after hours occupancy information.
- W. All applications programs shall be pre-engineered and pretested. Program entries shall utilize graphical templates.

- X. Workmanship:
  - 1. Contractor shall use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturers recommended methods of installation. In all respects, the workmanship shall be of the highest grade, and all construction shall be done according to the best practice of the trade. Unless otherwise noted, conduit shall be concealed and installed square to the building lines. Any work not meeting these requirements shall be replaced or rebuilt without extra expense to the Owner

1.3 RELATED SECTIONS

- A. Section 23 00 00 - Basic Mechanical Requirements
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- C. Section 26 00 00 - Basic Electrical Requirements

1.4 DEFINITIONS

- A. Energy Management Control System, Facility Management System, and Control System are to be considered the same.

1.5 REFERENCES

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
  - 2. ANSI/ASHRAE - Standard 135-2001, BACnet.
  - 3. Uniform Building Code (UBC), including local amendments.
  - 4. UL 916 - Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
  - 5. National Electrical Code (NEC).
  - 6. FCC Part 15, Subpart J, Class A.
  - 7. EMC Directive 89/336/EEC (European CE Mark).
  - 8. City, county, state, and federal regulations and codes in effect as of contract date.
  - 9. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.6 SPECIFICATION NOMENCLATURE

EMCS	Energy Management and Control System
WAN	Wide Area Network
RWS	Remote Work Station
HHI	Hand Held Interface
LAN	Local Area Network

1.7 QUALITY ASSURANCE

- A. Responsibility:
  - 1. The supplier of the EMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.
- B. Component Testing:
  - 1. Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.
- C. Tools, Testing and Calibration Equipment:
  - 1. The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.

## 1.8 SUBMITTALS

### A. Drawings

1. The system supplier shall submit detailed complete, engineered drawings, control sequence, and bill of materials for approval.
2. The contractor shall supply one electronic copy of the submittal.
3. The electronic files will either be e-mailed to the architect or posted to a project management and information exchange website, depending on the architect's requirements. The architect and contractor can distribute copies of the files as desired.
4. The engineer will retain an electronic copy of the submittal and all responses.

### B. System Documentation

1. Include the following in submittal package:
  - a. Data sheets for all pieces of equipment.
  - b. System configuration diagrams in simplified block format.
  - c. All input/output object listings and an alarm point summary listing.
  - d. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
  - e. Complete bill of materials, valve schedule, and damper schedule.
  - f. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
  - g. Overall system operation and maintenance instructions including preventive maintenance and troubleshooting instructions.

C. For all system elements - operator's workstation(s), building controller(s), application controllers, routers, and repeaters, provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.

D. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.

E. A list of all functions available and a sample of function block programming that shall be part of delivered system.

#### 1. Scheduling

- a. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.

#### 2. Drawings and Manuals:

- a. Upon completion of the work, the Contractor shall provide the Owner with "record" layouts for the system. Layouts shall indicate all equipment and the function of each item shall be indicated.

3. Operating instructions and as-built system flow diagrams and drawings shall be prepared, bound, and delivered to the Owner. Each sensor, relay, switch, motor, controller, indicator (when inside panel), and item of equipment, etc., shall be identified with a number or mark identical to one which shall be tagged on each item. Large items of equipment may be identified by a suitable symbol listed in a legend on the control diagram.

## 1.9 EMCS CONTRACTOR QUALIFICATION REQUIREMENTS

A. The Energy Management Control System Manufacturer/Contractor, to be acceptable to this project, must have had an established engineering and service office serving the Owner's area for a minimum of five years prior to bid date of this project and be the authorized installing contractor for the manufacturer of the BACnet components. This office shall have a staff of factory trained technicians fully capable of rendering training, instruction, calibration procedures, and routine and emergency maintenance service on all system components furnished.

B. Installers shall have not less than five years' experience with electronic and pneumatic controls.

- C. The entire system shall be provided by a qualified and approved Controls Manufacturer/Contractor. It shall be designed by engineers and installed by competent technicians, all of which are regularly employed by the manufacturer of the control equipment. The Manufacturer/Contractor shall maintain permanent local facilities for engineering, installation, and 24-hour maintenance and service. Submit required Qualifications Form as specified. The manufacturer shall provide evidence of the ability to support and service the work in the Owner's facilities.
- D. The Bidder/Contractor shall be certified by the manufacturer of the equipment and have factory trained installers
- E. Equipment and performance are intended as a standard of quality, but not as a means of excluding other approved Manufacturers/Control Contractors.

#### 1.10 WARRANTY

- A. The temperature control contractor shall guarantee all workmanship and material in the installed temperature regulation system for a period of one (1) year, such guarantee dating from the date of final acceptance of the entire air conditioning system by the Architect/Engineer.
- B. This warranty shall cover the repair or replacement without additional costs to the Owner of any defective materials, parts, etc. of facility workmanship.
- C. During the warranty period, the temperature controls contractor shall respond to calls for warranty service within eight (8) working hours. Emergency service shall be obtainable within four (4) hours of notification by the Owner. Emergency service shall be obtainable on a 24-hour basis, seven (7) days per week.
- D. The temperature control contractor's office shall be within a 150-mile radius of the job site.
- E. Warranty Access:
  - 1. The Owner shall grant to the Contractor, reasonable access to the EMCS system during the warranty period. The owner shall provide, at no cost to the contractor, remote software access to an on-site computer or VPN access for the following functions:
    - a. Access to the entire facility control system by the contractor to provide service and diagnostic support.
- F. Service:
  - 1. All service of the system shall be furnished by the Contractor, at no cost to the Owner, for a period of one (1) year, concurrent with the warranty period specified above.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE EMCS VENDORS

- A. Alerton - Climatec
- B. The Engineer and Owner shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications.

### 2.2 MATERIALS

- A. General: All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.
- B. Exceptions to the specification will qualify bid as unacceptable.

### 2.3 OPERATOR'S WORKSTATION

- A. This system is an addition to the existing control system and shall be connected to the existing local area network (LAN) and computer. No additional workstation is required.
- B. The new graphics software shall be fully integrated to the owners existing front end software and existing workstation. Floor plan and interactive color graphics shall be provided for the school with each zone providing color indication of the zone comfort level. In addition to the floor plan graphic, each piece of controlled equipment shall be represented by a graphic that is accessible by clicking on the zone or indicated piece of equipment. All points shall be available on the graphic.

## 2.4 BUILDING CONTROLLER

- A. This system is an addition to the existing control system and shall be connected to the existing building controller if feasible. Field verify if existing building controller can be expanded or if additional building controller(s) is necessary.
- B. General:
1. All communication with operator workstation and all application controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), at least 4 master slave token passing (MS/TP) LANs, a point-to-point (PTP - RS-232) connection and an on-board modem.
    - a. Each MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
    - b. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
    - c. The direct access port must be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.
  2. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.
  3. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.
  4. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.
  5. Building controller shall provide battery-backed real-time (hardware) clock functions.
  6. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative).
  7. Global control algorithms and automated control functions should execute via 32-bit processor.
  8. Controller installation shall include memory-free gel-cell battery providing ongoing power conditioning and noise filtering for operation data integrity. It shall provide up to 5 minutes of powerless operation for orderly shutdown and data backup.
  9. BACnet Conformance:
    - a. Building Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a Native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
    - b. Clock Functional Group
      - 1) Files Functional Group
      - 2) Reinitialize Functional Group
      - 3) Device Communications Functional Group
      - 4) Event Initiation Functional Group
  10. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  11. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  12. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).



- C. Schedules:
  - 1. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- D. Logging Capabilities:
  - 1. Each building controller shall log as minimum 1000 trendlogs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
  - 2. Logs may be viewed both on-site or off-site via remote communication.
  - 3. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.
  - 4. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
  - 5. Alarm Generation:
    - a. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
    - b. Each alarm may be dialed out as noted in paragraph 2 above.
    - c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
    - d. Controller must be able to handle up to 1500 alarm setups stored as BACnet event enrollment objects - system destination and actions individually configurable.

## 2.5 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., to allow the Web browser to function with the EMCS shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
  - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security authentication and encryption techniques to prevent unauthorized access shall be implemented.
  - 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
  - 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
  - 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
  - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual
  - 6. "refresh" of the Web page.
  - 7. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
    - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
      - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
    - b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
    - c. View logs and charts

- d. View and acknowledge alarms
  8. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
  9. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
- 2.6 TERMINAL UNIT APPLICATION CONTROLLERS (ROOFTOPS, HEAT PUMPS, AC UNITS, FAN COILS)
- A. General:
    1. Provide one Native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output, and self-contained logic program as needed for complete control of unit.
  - B. BACnet Conformance:
    1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4, and 76.8 Kbps, as a Native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
      - a. Files Functional Group
      - b. Reinitialize Functional Group
      - c. Device Communications Functional Group
    2. Refer to section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
    3. Standard BACnet object types supported shall include as a minimum-Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
    4. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0-5 VDC, 4-20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
    5. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
    6. Application controller shall include support for intelligent room sensor (see Section 2.9.B.). Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
  - C. Smoke Detectors:
    1. Smoke detectors (duct and area type) shall be provided, installed, and wired into the Fire Alarm System by the Electrical Contractor. The Controls Contractor shall be responsible for interlock wiring between duct smoke detectors and control relays, and starter safety circuits.
- 2.7 ELECTRONIC ACTUATORS
- A. General:
    1. Shall be Electric unless otherwise specified.
    2. Shall be manufactured by Belimo. Equal substitutions allowed with written approval by owner prior to bid.

3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
  4. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
  5. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma) and provide to VAV box manufactured for factory installation.
  6. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
  7. Primary valve control shall be Analog (2-10vdc, 4-20ma).
  8. UL Listed Standard 873 and Canadian Standards Association Class 481302 shall certify Actuators.
  9. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
  10. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
  11. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
  12. A push button gearbox release shall be provided for all non-spring actuators.
  13. Modulating actuators shall be 24VAC and consume 10VA power or less.
  14. Conduit connectors are required when specified and when code requires it.
- B. Damper Actuators:
1. All damper actuators shall be provided and installed by EMCS contractor.
    - a. Electronic damper actuators shall be direct-coupled rotary type, suitable for mounting directly on the damper end shaft. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. Damper actuators used on economizer and/or outside air dampers shall be spring return.
    - b. Terminal unit damper actuators shall be electric, low voltage, utilizing floating control.
    - c. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- C. Economizer Actuators shall be provided and installed by EMCS contractor. Actuators shall utilize Analog control 2-10 VDC and shall give position feedback for Fault Detection and Diagnostics (FDD) monitoring. Floating control is not acceptable. Actuators shall be Mechanical Spring Return. Equal to Belimo LF-24-SR.
1. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
  2. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
  3. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)
- D. Valve Actuators ½" to 6":
1. Electronic valve actuators shall be suitable for direct-coupled mounting to the valve bonnet. Valve actuators shall be properly sized to provide sufficient torque to position the valve throughout its operating range. Where butterfly valves are specified, double acting non-spring return actuators may be used. Unless otherwise stated, provide normally open valves for heating water applications and normally closed valves for chilled water applications.
  2. Terminal unit reheat valve actuators shall be suitable for direct-coupled mounting to the valve bonnet. Valve actuators shall be properly sized to provide sufficient torque to position the valve throughout its operating range. Non-spring return tri-state floating valve actuators may be used on terminal units where the valve is less than 1 inch.

3. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail save flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
4. All zone service actuators shall be non-spring return unless otherwise specified.
5. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
6. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
7. Override handle and gearbox release shall be provided for all non-spring return valve actuators.

E. Butterfly Valve Industrial Actuators:

1. Actuators shall be approved under Canadian Standards Association or other Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
2. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1-phase, 60 Hz supply. Two adjustable cam actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
3. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
4. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
5. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.
6. The actuator shall be Analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2-10 VDC, 4-20 mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.
7. Performance Verification Test
  - a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate which is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
  - b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.

2.8 DAMPERS AND VALVES

A. Control Dampers:

1. Control air dampers shall be parallel blade for two-position control and opposed blade for modulating control applications. Dampers shall be galvanized with nylon bearings. Blade edge and tip seals shall be included for all dampers. Leakage through the damper shall not exceed 4 CFM per square foot at 1" w.c. Blades shall be 16-gauge minimum and 10" wide maximum and frame shall be of welded channel iron. Dampers over 48" wide shall be equipped with a jackshaft to provide sufficient force throughout the intended operating range.
2. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
4. Damper linkage hardware shall be constructed of aluminum or corrosion resistant zinc & nickel- plated steel and furnished as follows:
  - a. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.

- b. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
- B. Multiple Section Dampers:
  1. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
    - a. Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
    - b. Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
    - c. Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
  2. Damper manufacturer shall supply alignment plates for all multi-section dampers.
  3. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
  4. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8" wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
  5. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12" minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.
- C. Actuator mounting for damper and valve arrangements shall comply to the following:
  1. Damper Actuators: Shall not be installed in the air stream
  2. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
  3. Damper or valve actuator ambient temperature shall not exceed 122°F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.
  4. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
  5. Damper mounting arrangements shall comply to the following:
    - a. The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
    - b. No jack shafting of damper sections shall be allowed.
    - c. Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.
- D. Valve Sizing for Water Coil:
  1. On/Off Control Valves shall be line size.
  2. Modulating Control Valve Body Size may be reduced at most two pipe sizes from the line size or not less than ½ the pipe size. The BAS contractor shall size all water coil control valves for the application as follows:
    - a. Booster-heat valves shall be sized not to exceed 4-9 psi differential pressure. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop. Control valve authority must be selected by representing at least 25% to 50% of the system loop pressure drop. The calculation will be performed and shown for each individual control valve using the available pressure drop from the pump discharge at the specific installation location of the control valve. Any control valves that do not meet the minimum 25% will be re-selected or approved for use by the Engineer.
    - b. Primary valves shall be sized not to exceed 5-15 psi differential pressure. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop. Control valve authority must be selected by representing at least 25% to 50% of the system loop pressure drop. The calculation will be performed and shown for each individual control valve using the available pressure drop from the pump discharge at the specific installation location of the control valve. Any control valves that do not meet the minimum 25% will be re-selected or approved for use by the Engineer.

- c. Butterfly valves shall be sized for modulating service at 60-70 degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.
- E. Valve mounting arrangements shall comply to the following:
1. Unions shall be provided on all ports of two-way and three-way valves.
  2. Install three-way equal percentage Characterized Control valves in a mixing configuration with the
  3. "A" port piped to the coil.
  4. Install 2½ inch and above, Three-Way globe valves, as manufactured for mixing or diverting service to the coil.
  5. Two-way valve shall be piped in the return side of the coil in order to minimize ambient heat at the coil.
- 2.9 ENCLOSURES
- A. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
  - B. All controllers, power supplies, and relays shall be mounted in enclosures.
  - C. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
  - D. Enclosures shall have hinged, locking doors.
  - E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.
  - F. All direct digital controllers located indoors shall be installed in NEMA 1 enclosures. All direct digital controllers located outdoors shall be installed in NEMA 3R enclosures. Enclosures shall be of suitable size to accommodate all power supplies, relays, and accessories required for the application. Each enclosure shall include a perforated subpanel for direct mounting of the enclosed devices. Include matched key locks for all enclosures provided.
- 2.10 SENSORS, SWITCHES, CONTROLLERS, TRANSDUCERS, AND MISCELLANEOUS DEVICES
- A. Temperature Sensors:
    1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
  - B. Intelligent Room Sensor with LCD Readout:
    1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
    2. The Intelligent Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity, and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
    3. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
    4. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
    5. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to VAV controller, VAV box shall be balanced and all airflow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

- C. Field Service Tool:
  - 1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
  - 2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.
  - 3. Provide Field Service Tool(s) for this project.
- D. Network Connection Tool:
  - 1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
  - 2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.
  - 3. Provide 1 Network Connection Tool for this project.
- E. Differential Pressure Switches (Air):
  - 1. Provide differential pressure switches across fans and filters for status indication. Differential pressure switches shall have an adjustable setpoint from 0.05" w.c. to 2" w.c. with a switch differential that progressively increases from 0.02" w.c. at minimum to 0.8" w.c. at maximum. Switch shall be SPDT rated for 15A (non-inductive) at 277VAC.
- F. Differential Pressure Switches (Liquid):
  - 1. Provide differential pressure switches across pumps and chillers to prove flow. Differential pressure switches shall have a 0-150 psig working differential pressure and have an adjustable setpoint from 4" w.c. to 43.5" w.c. on a fall and 5.5" w.c. to 45" w.c. on a rise. Liquid differential pressure switch enclosure shall carry a NEMA 4 rating. Switch shall be SPDT rated for 5A (inductive) at 125VAC.
- G. Float Switches:
  - 1. Provide float switches in condensate drain pans as required by code. Float switches shall utilize a magnetically actuated dry reed switch. Float shall be constructed of seamless polypropylene. Switch shall be SPDT rated for 16A (non-inductive) at 120VAC.
- H. Mixed Air Low Limit Controllers (Freezestats):
  - 1. Mixed air low limit controllers shall be manual reset, adjustable setpoint with 20-foot element serpentine across the entering air face of center cooling coil. Control shall be responsive only to the lowest temperature along the element.
- I. Static High Limit Controllers:
  - 1. Discharge static high limit controllers shall be provided on all VAV AHU systems. When discharge static pressure exceeds setpoint, the supply fan shall be de-energized. Manual reset shall be required.
- J. Static Pressure Transducers (Air):
  - 1. Provide static pressure transducers for monitoring supply duct static pressure. Static pressure transducers shall be 100% solid state and shall include glass on silicon, ultra stable capacitance sensors. Each static pressure transducer shall incorporate short circuit and reverse polarity protection. Transmitter output shall be either 0-10VDC or 4-20mA. Static pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transmitter's operating range.
- K. Differential Pressure Transducers (Air):
  - 1. Provide differential pressure transducers for monitoring air system and airflow measuring station differential pressures. Differential pressure transducers shall be 100% solid state and shall include glass on silicon, ultra stable capacitance sensors. Each differential pressure transducer shall incorporate short circuit and reverse polarity protection. Transducer output shall be either 0-10VDC or 4-20mA. Differential pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transducer's operating range.
- L. Current Sensing Relays:
  - 1. Provide current switches for indication of equipment status. Amperage ratings shall be adjustable with the desired setpoint to be in the top 50% of the current relay's operating range. Current sensing relays shall incorporate trip indication LED's and shall be sized for proper operation with the equipment served.

- M. Relative Humidity Sensors:
  - 1. Relative humidity sensors shall have an accuracy of +/- 2% from 5 to 95% RH. Output signal shall be either be 0-10VDC or 4-20mA. Humidity transmitters shall be factory calibrated and require no field setting.
- N. CO2 Sensors:
  - 1. CO2 sensors shall be space or duct mounted carbon dioxide sensors as required by the application. Space CO2 sensors shall be mounted next to space temperature sensors. The sensor shall have a range of 0-2000 ppm with an accuracy of  $\pm 5\%$ . The response time for the sensor shall be less than one minute. The sensor shall be capable of providing an analog signal proportional to the CO2 level sensed. The signal shall be either 0-10VDC or 4-20mA.
- O. Duct/Well Sensors:
  - 1. Sensors for duct and water temperature sensing shall incorporate either RTD or Thermistor sensing devices. Sensing element accuracy shall be 0.1% over the sensor span or better. Where the element is being used for sensing mixed air or coil discharge temperatures and/or the duct cross sectional area is in excess of 14 square feet, the element shall be of the averaging type. Averaging duct sensors shall utilize a 6, 12, or 24 foot sensing element. Immersion sensors shall use matched 316 stainless steel bulb wells. All duct and immersion sensors shall be provided with conduit connection housings. Sensors shall be provided with adequate standoffs for insulation installation.
- P. Selector Switches:
  - 1. Selector switches shall be 2 or 3-position, knob, or key type as required by the sequence of operation. Selector switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch position.
- Q. Pushbutton Switches:
  - 1. Pushbutton switches shall be either maintained or momentary as required by the sequence of operation. Pushbutton switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch function.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owners` representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.
- D. Each bid must include all costs associated with providing wiring, conduit, concrete trenching, and earth trenching.

#### **3.2 OPERATION**

- A. BACnet Object List:
  - 1. The following points as defined for each piece of equipment are designated as follows:
    - a. Binary Out (BO) - Defined as any two-state output (start/stop) (enable/disable), etc.
    - b. Binary In (BI) - Defined as any two-state input (alarm, status), etc.
    - c. Analog In (AI) - Defined as any variable input (temperature) (position), etc.
    - d. Analog Out (AO) - Defined as any electrical variable output. 0-20mA, 4-20mA, and 0-10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.
  - 2. Each and every point will be checked out by the Contractor and the Owner`s Representative will inspect each point with the bidder prior to acceptance. Provide complete written documented inspections, test, and checkout report. Calibrate all equipment.
- B. DDC Object Type Summary:
  - 1. Provide all database generation.



2. Displays:
  - a. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
3. Run Time Totalization:
  - a. At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
4. Trendlog:
  - a. All binary and analog object types (including zones) shall have the capability to be automatically trended.
5. Alarm:
  - a. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
6. Database Save:
  - a. Provide backup database for all stand-alone application controllers on disk.

### 3.3 INSTALLATION

- A. General:
  1. Install in accordance with manufacturer's instructions.
  2. Provide all miscellaneous devices, hardware, software, interconnections installation, and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.
  3. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.
- B. Location and Installation of Components:
  1. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
  2. Enclosures and hardware or wiring shall not block or limit accessibility to service compartments of any other equipment.
  3. The work shall be coordinated fully, as it pertains to the fire protection system, fire alarm system, and electrical power system. All items shall be terminated in the DDC controllers in a predetermined order as indicated in the submittal drawings.
  4. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
  5. Identify all equipment and panels. Provide permanently mounted tags for all panels.
  6. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections - sized to suit pipe diameter without restricting flow.
- C. Interlocking and Control Wiring:
  1. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26 and all national, state, and local electrical codes.
  2. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
  3. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
  4. Provide auxiliary pilot duty relays on motor starters as required for control function.
  5. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings. Coordinate with electrical contractor.
  6. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in conduit. All other wiring to be installed neatly and inconspicuously per local code requirements. If local code allows, control wiring above accessible ceiling spaces may be run with plenum rated cable (without conduit).

D. Installation Requirements:

1. Any panels associated with the control system shall be furnished and installed under this section of the work. Panel wiring shall be terminated by connecting to numbered terminals strips. Wire nut connections shall not be allowed. All wiring shall be color coded and shall be tagged for future identification.
2. Unless otherwise specified, all devices, panels, etc., furnished and/or installed by the Contractor shall be located where they can be calibrated and maintained from the floor without use of a ladder. These items shall be identified by means of plates made of plastic suitably engraved, embossed, or punched, plastic tape will not be acceptable. At completion of job, the Contractor shall submit record drawings of any changes made during construction. This submittal shall be a condition of final payment.
3. Any conduit on roof shall be absolute minimum and shall have prior written approval.
4. All conduit used indoor and outdoor shall be metal and shall be of type and fittings to minimize corrosion and moisture entry.

E. Cable Installation and Attachments:

1. Control System wiring and equipment installation shall be in accordance with good engineering practices as established by the TIA/EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts. All cable shall be supported from the building structure and bundled.
2. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling. Controls cables shall not be run loose on ceiling grid or ceiling tiles. Support shall be provided by mounting appropriate fasteners which may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. All cabling and supports must be positioned at least 12 inches above the ceiling grid.
3. Controls cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with wire wraps randomly spaced at 30 to 48 inches on center, wire wraps shall not be tight enough to deform cabling and shall not be used to support the cabling.
4. Attachments for cabling support shall be spaced at 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12 inches mid-span between attachments. Attachments shall be sized as follows:
  - a. Bundles up to 1/2" dia. (Ten 1/4" cables) 2" bridle ring, Caddy #4BRT32 or equivalent
  - b. Bundles up to 3/4" dia. (Sixteen 1/4" cables) 3/4" J-Hook, Caddy #CAT12 or equivalent
  - c. Bundles up to 1-5/16" dia. (Fifty 1/4" cables) 1-5/16" J-Hook, Caddy #CAT21 or equivalent
  - d. Bundles up to 2" dia. (Eighty 1/4" cables) 2" J-Hook, Caddy #CAT21 or equivalent Split bundles greater than 2" dia. or provide cable tray.
5. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm, 25 volt speaker cable). Multiple J-Hooks can be on the same attachment point up to the rated weight of the attachment device.
6. Controls cables shall be run in conduit stubs, where stubs are provided, from wall mounted devices to above accessible ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide a plastic snap bushing or sleeve on the end of each conduit stub such as Thomas & Betts Catalog no. 443 - 3/4", 424 - 1", 425 - 1 1/4", 427 - 2" or equivalent.
7. Conduit, duct, or track shall be used for controls cable in exposed areas.
8. All conduit, ducts, track and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices and techniques for each type of cable used.
9. All penetrations through fire rated walls or floors shall feature a short length of metal conduit. The hole shall be neatly cut, not oversize or irregular. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire-stop caulk or putty, such as Minnesota Mining & Mfg. Co. (3M) - CP 25WB+ caulk, MPS-2+ putty, or equivalent. Install according to the manufacturers' instructions.

10. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film, and non-smear nylon marking pens. Utilize Tyton Corporation Part No. RO175 Rite-On labels and Part No. FTP1 nylon marking pens or equivalent.
11. Each cable run shall include a three foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
12. No terminations or splices shall be installed in or above ceilings. Cable shall be continuous from one device termination to the next.
13. Mount all equipment firmly in place. Route cable in a professional, neat, and orderly installation.
14. All cabling shall be placed with regard to the environment, EMI/RFI (interference) and its effect on communication signal transmission.
15. Do not route any controls cable within two feet of any light fixture, HVAC unit service access area, electric panel, or any device containing a motor or transformer.
16. Low voltage controls cable will not be installed in the same conduit, duct or track with line voltage electrical cable.
17. Maximum pulling tension should not exceed 25 lb/ft. or manufactures recommendation, whichever is less.
18. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
19. Cable bends shall not exceed the manufacturers` suggested bend radius.
20. Provide for adequate ventilation in all equipment panels.
21. Provide wiremold where wiring must run exposed. Obtain advance approval from Architect and Owner before running exposed. Coordinate with Owner and Architect.
22. For all wiring, provide numbering on all terminations (both ends).
23. Label all panels, cans, enclosures, controllers and correlate with air conditioning units served. Labeling shall relate to shop drawings and equipment served. Provide wiring diagram inside each enclosure.
24. Provide a rain-tight enclosure for each rooftop unit controller.
25. Locate outdoor air sensors shielded and on northern exposure.

F. Termination practices:

1. Strip back only as much cable jacket as required to terminate.
2. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
3. Avoid twisting cable during installation.
4. Electrical Interlocks:
  - a. All electrical interlocks shall be provided as specified. All electrical interlocks shall be made by means of motor starters or shall be accomplished by separate relays. No motor power lead shall be utilized in an interlock circuit.

3.4 SERVICES

A. Field Services:

1. Prepare and start logic control system under provisions of this section.
2. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
3. Provide the capability for off-site monitoring at control contractor`s local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for 1 year or as specified.
4. Provide Owner`s Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

B. HVAC Training:

1. Provide application engineer to instruct owner in operation of systems and equipment.
2. Provide system operator`s training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands, and request of logs. Provide this training to a minimum of 3 persons.
3. Provide on-site training above as required, up to 16 hours as part of this contract.

C. Demonstration:

1. Provide systems demonstration under provisions of Section 23 00 00.
2. Demonstrate complete operating system to owner`s representative.
3. Provide certificate stating that control system has been tested and adjusted for proper operation.

- D. Programming:
1. Prior to completion of the control installation, schedule time with Owner's designated representatives to evaluate and select programming options and requirements. Contractor shall provide engineer for such meetings and consultations on an as-needed basis. Preparation time for the conference shall be in addition to the "in conference" time, and shall be provided on an as-needed basis without additional cost to the Owner.
  2. The Contractor shall also provide additional coordination as needed with the Owner's representative and Engineer to formulate and determine functions, reports, graphics, and alarms most desirable and suitable for the school district and writing the software capability. Programming of these items shall be provided. The Contractor shall program the system using coordinated Owner provided schedules for time of day and holidays.
  3. No hardware change shall be required for program changes.
- E. Documentation:
1. The Contractor shall provide a complete documentation package to the owner which shall include floor plans indicating location of EMCS equipment, wiring diagrams, bill of materials, data base information, and sequences of operation. The sequences of operation shall be submitted and approved by the owner in writing prior to installation and programming.
- F. Coordination:
1. For construction project installations where electrical and mechanical contractors are responsible for their respective trade, the electrical contractor is to provide line voltage to required equipment and the mechanical contractor is to install any devices that are to be included in systems. It is the controls contractor's responsibility to provide all devices with diagrams for location and coordinate with mechanical contractor prior to mechanical contractor starting installations. Controls contractor shall coordinate and provide all required work and wiring for duct mounted smoke detectors, control relays for unit shutdown, and interface with any fire alarm system. For installations where controls only work is provided, all necessary work shall be performed by the controls contractor.

#### **PART 4 - SEQUENCE OF OPERATION**

##### **4.1 SEQUENCE OF OPERATION**

- A. The following are sequences of operations which will be accomplished by the EMCS. Coordinate with Owner in operating equipment to maximize comfort and economy. All points required to accomplish the sequences will be provided and connected to the EMCS.
- B. DDC Control - Rooftop Units, Split Systems, DX Units, and Heat Pumps: Each unit shall be started and stopped by the EMCS. Automatic override during low or high ambient temperatures shall be provided. Provide one outdoor air sensor per school. Provide an indoor air space sensor for every unit to monitor space temperature, and be capable of remote resetting space temperature by Owner.
- C. Provide one outside air relative humidity sensor and temperature sensor per campus. It is also acceptable to obtain outside air ambient conditions from a nearby weather station.
- D. Acronyms:
1. EMCS - Energy Management Control System. The EMCS controls all of the HVAC functions as well as lighting schedules and lawn sprinkler schedules.
  2. TCS - Temperature Control Sensor. This is the device that controls the temperature in the space. VFD - Variable Frequency Drive.
  3. DDC - Direct Digital Control. OAU - Outside Air Unit.
  4. CO2 - Carbon Dioxide.
  5. CFM - Cubic Feet per Minute GPM - Gallons Per Minute A/H - Air Handler
  6. F/C - Fan Coil Unit CHW - Chilled Water HW - Hot Water
  7. VAV - Variable Air Volume UCP - Unit Control Panel
  8. ppm - Parts Per Million - A measurement of the concentration of one substance within another. In this case, it is the number of CO2 particles in a sample of one million air particles.
  9. Adj - Adjustable - All set points are assumed to be adjustable whether specified or not. The set points specified are values that should be programmed initially but can be changed if necessary.

- E. Definitions:
1. Occupancy Period:
    - a. The period of the day that the owner wants the environmental conditions acceptable for occupancy. Outside air ventilation may not be enabled at all times during the occupancy period. This schedule will be defined for each component of the HVAC system and will not be the same for all components.
  2. Outside Air Schedule:
  3. The period of the day that outside air ventilation is enabled. This schedule will be defined for each component of the HVAC system.
  4. Warm-up Mode:
  5. The time between the end of the unoccupied and start of the occupied period during which the space temperature is increased (night setback) to the normal occupancy temperature.
  6. Cool-down Mode:
  7. The time between the end of the unoccupied and start of the occupied period during which the space temperature is lowered (night setup) to the normal occupied temperature.
  8. Unoccupied Period:
  9. The period of the day that the temperature control setting is lowered (heating) or raised (cooling) to conserve on the amount of energy required to condition the building. The fans are also turned "OFF" to conserve energy.
- F. Documentation:
1. The Contractor shall provide a complete documentation package to the owner which shall include floor plans indicating location of EMCS equipment, wiring diagrams, bill of materials, database information, and sequences of operation. The sequences of operation shall be submitted and approved by the owner in writing prior to installation and programming.

END OF SECTION 23 09 23

**SECTION 23 09 23.1**

**SEQUENCE OF OPERATIONS GENERAL**

**PART 1 - GENERAL – NOT USED**

**PART 2 - PRODUCTS – NOT USED**

**PART 3 - EXECUTION**

3.1 CONTROL

A. Building Electrical:

1. General:

- a. Provide digital monitoring of building MSB. The EMCS shall monitor the electrical energy consumption at the buildings main electric feed. Coordinate with switchgear manufacturer and/or electrical contractor.
- b. Provide dashboard with daily, weekly, monthly, and yearly usage totals.

2. Control Points:

Description	Type
KVA	AI
KWH	AI
Demand	AI
Power Factor	AI
Voltage	AI

B. Exterior Lighting:

1. General:

- a. Provide auxiliary contactor(s) to control lighting. Include all hardware and software required and connect to nearest EMCS controller. Coordinate with electrical contractor.

2. Control Points:

Description	Type
Photocell	AI/DI
Lighting Contractor	DO

C. Lighting Control System:

1. General:

- a. BACnet network controller for lighting system shall be provided by the electrical/lighting contractor. Coordinate with electrical/lighting contractor on interface being provided and associated with points.
- b. Provide lighting floorplan layer with relevant lighting data displayed.

D. Domestic Water Heater:

1. General:

- a. The domestic hot water heater(s) and associated circulating pump(s) shall be disabled/enabled by the EMCS based on a time schedule. The domestic hot water supply for the hot water heater shall be monitored and shall generate an alarm upon exceeding above or dropping below its assigned alarm limits (adj.). The points required to accomplish this sequence shall be connected to the nearest available EMCS controller.

2. Control Points:

Description	Type
Loop Hot Water Supply Temperature (Each Water Heater)	AI
Water Heater Amps/Status (Each Water Heater)	AI
Circulation Pump Amps/Status (Each Pump)	AI
Water Heater Start/Stop Command (Each Water Heater)	DO
Circulation Pump Start/Stop Command (Each Pump)	DO

E. Domestic Water Main Supply Monitoring:

1. General:

- a. The EMCS contractor shall provide a flow meter (Omni Compound C2 water flow meter or equivalent) to be installed on the main domestic water line. Coordinate with plumbing contractor.
- b. The EMCS shall monitor flow from the primary water supply to the building. When the amount of flow is greater than programmed (adj.) the EMCS shall send an alarm. Provide all flow meters and controls points for a complete system. Provide dashboard with daily, weekly, monthly, and yearly usage totals.

2. Control Points:

Description	Type
Flow Meter	AI

F. Ambient Conditions:

1. General:

- a. The EMCS shall monitor the ambient outside conditions at the building. Sensors shall be located outside the building for northern exposure.

2. Control Points:

Description	Type
Outside Temperature	AI
Outside Humidity	AI
Outside CO2	AI

G. Gang Toilet & Dressing Room Exhaust Fans (EF-1 & EF-2):

1. General:

- a. Fans to be disabled/enabled by the EMCS based on a time schedule.

2. Control Points:

Description	Type
Fan Amps/Status (Each Fan)	AI
Fan Start/Stop Command (Each Fan)	DO

H. Workshop Exhaust Fan (EF-3)

1. General:

- a. Fans to be disabled/enabled by the EMCS based on RTU-7 Operation. When RTU-7 is operational then EF-3 shall run, when RTU-7 is off then EF-3 shall be off.

2. Control Points:

Description	Type
Fan Amps/Status (Each Fan)	AI
Fan Start/Stop Command (Each Fan)	DO

3.

I. MFD/IDF Rooms:

1. General:

- a. The EMCS shall monitor space temperature for all MDF/IDF rooms. The EMCS shall generate an alarm should the space temperature exceed or drop below its assigned alarm limits (adj.)

2. Control Points:

Description	Type
Space Temperature (Each Room)	AI

J. Generator:

1. General:

- a. The EMCS shall interface and integrate the emergency generator(s). The system shall monitor and display all relevant information available such as but not limited to, alarms, status, unit operation mode, temperatures, and runtime. Coordinate with electrical contractor and manufacturer on interface being provided

END OF SECTION 23 09 23.1

## SECTION 23 11 23

### FACILITY NATURAL-GAS PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Joining materials.
  - 4. Manual gas shutoff valves.
  - 5. Motorized gas valves.
  - 6. Earthquake valves.
  - 7. Pressure regulators.
  - 8. Service meters.
  - 9. Dielectric fittings.

##### 1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. An example includes rooftop locations.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Piping specialties.
  - 2. Corrugated, stainless steel tubing with associated components.
  - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 4. Pressure regulators. Indicate pressure ratings and capacities.
  - 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings.
  - 6. Dielectric fittings.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
  - 1. Shop Drawing Scale: 1/4 inch per foot.
  - 2. Detail mounting, supports, and valve arrangements for service-meter assembly and pressure regulator assembly.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Welding certificates.
- C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- D. Field quality-control reports.
- E. Qualification Statements: For professional engineer.



1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For motorized gas valves pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators in accordance with the ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping in accordance with requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide purging and startup of natural-gas supply in accordance with requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.
  - 2. Do not proceed with interruption of natural-gas service without Owner's written permission.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed and concealed behind finished surfaces. Comply with requirements in Section 08 31 13 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 22 05 53 "Identification of Plumbing Piping and Equipment."

**PART 2 - PRODUCTS**

2.1 SOURCE LIMITATIONS

- A. Obtain each product type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 54 the International Fuel Gas Code.
- B. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
  - 3. Minimum Operating Pressure of Service Meter: 5 psig.
- C. Natural-Gas System Pressure within Buildings:
  - 1. Single Pressure: 0.5 psig or less.
  - 2. Two pressure ranges. Primary pressure is more than 0.5 psig, but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
  - 3. Two pressure ranges. Primary pressure is more than 2 psig, but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig, but not more than 2 psig.

4. Three pressure ranges. Primary pressure is more than 2 psig, but not more than 5 psig, and is reduced to secondary pressures of more than 0.5 psig, but not more than 2 psig, and is reduced again to pressures of 0.5 psig or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Seismic Performance: Natural-gas piping system is to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
  1. The term "withstand" means "the piping system will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the piping system will be fully operational after the seismic event."
  2. Component Importance Factor: 1.5.
  - 3.

### 2.3 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
  1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
  3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
  6. Mechanical Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Baker Hughes Company.
      - 2) Smith-Blair, a Xylem brand.
    - b. Stainless steel flanges and tube with epoxy finish.
    - c. NBR seals.
    - d. Stainless steel bolts, washers, and nuts.
    - e. Coupling is to be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    - f. Steel body couplings installed underground on plastic pipe are to be factory equipped with anode.
- B. Corrugated, Stainless Steel Tubing: Comply with ANSI/IAS LC 1/CSA 6.26.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. FlashShield Products; Gastite, a division of Titeflex Corp.
    - b. TracPipe CounterStrike; Omega Flex, Inc.
    - c. Tru-Flex Metal Hose Corp.
  2. Tubing: ASTM A240/A240M, corrugated, Series 300 stainless steel.
  3. Coating: PE with flame retardant.
    - a. Surface-Burning Characteristics: As determined by testing identical products in accordance with ASTM E84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 50 or less.
  4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
  5. Striker Plates: Steel, designed to protect tubing from penetrations.

6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections are to comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.
- C. Aluminum Tubing: Comply with ASTM B210 and ASTM B241/B241M.
  1. Aluminum Alloy: Alloy 5456 is prohibited.
  2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
  3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper-alloy fittings.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
- D. Drawn-Temper Copper Tube: Comply with ASTM B837, Type G.
  1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
    - a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    - b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.
  3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- E. Annealed-Temper Copper Tube: Comply with ASTM B837, Type G.
  1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
  3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- F. Tin-Lined Copper Tube: ASTM B280, seamless, annealed, with interior tin-plated lining.
  1. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
- G. PE Pipe: ASTM D2513, SDR 11.
  1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet is threaded or flanged or suitable for welded connection.
    - e. Tracer wire connection.
    - f. UV shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet is threaded or flanged or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. UV shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Suitable for joining PE pipe to PE pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Mueller Co. LLC; Mueller Water Products, Inc.
    - 2) Perfection Corporation.
    - 3) R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  - b. PE body with molded-in, stainless steel support ring.
  - c. Seals: NBR.
  - d. Acetal collets.
  - e. Electro-zinc-plated steel stiffener.
6. Plastic Mechanical Couplings, NPS 2 (DN 50) and Larger: Suitable for joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Mueller Co. LLC; Mueller Water Products, Inc.
    - 2) Perfection Corporation.
    - 3) R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.
  - b. Fiber-reinforced plastic body.
  - c. PE body tube.
  - d. Seals: NBR.
  - e. Acetal collets.
  - f. Stainless steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Suitable for joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Baker Hughes Company.
    - 2) Smith-Blair, a Xylem brand.
  - b. Stainless steel flanges and tube with epoxy finish.
  - c. Seals: NBR.
  - d. Stainless steel bolts, washers, and nuts.
  - e. Factory-installed anode for steel-body couplings installed underground.

#### 2.4 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  4. Corrugated, stainless steel tubing with polymer coating.
  5. Operating-Pressure Rating: 0.5 psig.
  6. End Fittings: Zinc-coated steel.
  7. Threaded Ends: Comply with ASME B1.20.1.
  8. Maximum Length: 72 inches.
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
  1. Copper-alloy convenience outlet and matching plug connector.
  2. Seals: Nitrile.
  3. Hand operated with automatic shutoff when disconnected.
  4. For indoor or outdoor applications.
  5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
  1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. Basket Strainers:
  1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
  - E. T-Pattern Strainers:
    1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
    2. End Connections: Grooved ends.
    3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 57 percent free area.
    4. CWP Rating: 750 psig.
  - F. Weatherproof Vent Cap:
    1. Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
- 2.5 JOINING MATERIALS
- A. Joint Compound and Tape: Suitable for natural gas.
  - B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
  - C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.
- 2.6 MANUAL GAS SHUTOFF VALVES
- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
    1. CWP Rating: 125 psig.
    2. Threaded Ends: Comply with ASME B1.20.1.
    3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
    4. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
    5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
    6. Service Mark: Valves NPS 1-1/4 to NPS 2 having initials "WOG" permanently marked on valve body.
  - B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
    1. CWP Rating: 125 psig.
    2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
    3. Tamperproof Feature: Locking feature for valves indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
    4. Service Mark: Initials "WOG" permanently marked on valve body.
  - C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. A.Y. McDonald Mfg. Co.
      - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
      - c. BrassCraft Manufacturing Co.; a Masco company.
    2. Body: Bronze, complying with ASTM B584.
    3. Ball: Chrome-plated brass.
    4. Stem: Bronze; blowout proof.
    5. Seats: Reinforced TFE; blowout proof.
    6. Packing: Separate packnut with adjustable-stem packing threaded ends.
    7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
    8. CWP Rating: 600 psig.
    9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
    10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
  - D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. A.Y. McDonald Mfg. Co.
      - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.

- c. BrassCraft Manufacturing Co.; a Masco company.
  2. Body: Bronze, complying with ASTM B584.
  3. Ball: Chrome-plated bronze.
  4. Stem: Bronze; blowout proof.
  5. Seats: Reinforced TFE; blowout proof.
  6. Packing: Threaded-body packnut design with adjustable-stem packing.
  7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  8. CWP Rating: 600 psig.
  9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - c. BrassCraft Manufacturing Co.; a Masco company.
  2. Body: Bronze, complying with ASTM B584.
  3. Ball: Chrome-plated bronze.
  4. Stem: Bronze; blowout proof.
  5. Seats: Reinforced TFE.
  6. Packing: Threaded-body packnut design with adjustable-stem packing.
  7. Ends: Threaded, flared, or socket as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  8. CWP Rating: 600 psig.
  9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Bronze Plug Valves: MSS SP-78.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Lee Brass Company.
  2. Body: Bronze, complying with ASTM B584.
  3. Plug: Bronze.
  4. Ends: Threaded, socket, or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  5. Operator: Square head or lug type with tamperproof feature where indicated.
  6. Pressure Class: 125 psig.
  7. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Mueller Co. LLC; Mueller Water Products, Inc.
    - c. XOMOX; Crane ChemPharma & Energy.
  2. Body: Cast iron, complying with ASTM A126, Class B.
  3. Plug: Bronze or nickel-plated cast iron.
  4. Seat: Coated with thermoplastic.
  5. Stem Seal: Compatible with natural gas.
  6. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
  7. Operator: Square head or lug type with tamperproof feature where indicated.
  8. Pressure Class: 125 psig.
  9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- H. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.

- b. Flowserve Corporation.
        - c. Homestead Valve: a division of Olson Technologies, Inc.
      - 2. Body: Cast iron, complying with ASTM A126, Class B.
      - 3. Plug: Bronze or nickel-plated cast iron.
      - 4. Seat: Coated with thermoplastic.
      - 5. Stem Seal: Compatible with natural gas.
      - 6. Ends: Threaded or flanged as indicated in "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles.
      - 7. Operator: Square head or lug type with tamperproof feature where indicated.
      - 8. Pressure Class: 125 psig.
      - 9. Listing: Valves NPS 1 and smaller are to be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
      - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
    - I. PE Ball Valves: Comply with ASME B16.40.
      - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a. Kerotest Manufacturing Corp.
        - b. Perfection Corporation.
        - c. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.
      - 2. Body: PE.
      - 3. Ball: PE.
      - 4. Stem: Acetal.
      - 5. Seats and Seals: Nitrile.
      - 6. Ends: Plain or fusible to match piping.
      - 7. CWP Rating: 80 psig.
      - 8. Operating Temperature: Minus 20 to plus 140 deg F.
      - 9. Operator: Nut or flat head for key operation.
      - 10. Include plastic valve extension.
      - 11. Include tamperproof locking feature for valves where indicated on Drawings.
    - J. Valve Boxes:
      - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a. Kerotest Manufacturing Corp.
        - b. Perfection Corporation.
        - c. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.
      - 2. Cast-iron, two-section box.
      - 3. Top section with cover with "GAS" lettering.
      - 4. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
      - 5. Adjustable cast-iron extensions of length required for depth of bury.
      - 6. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.
- 2.7 MOTORIZED GAS VALVES
  - A. Automatic Gas Valves: Comply with ANSI Z21.21.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Eaton.
      - b. Honeywell Building Solutions; Honeywell International, Inc.
      - c. Johnson Controls, Inc.
    - 2. Body: Brass or aluminum.
    - 3. Seats and Disc: NBR.
    - 4. Springs and Valve Trim: Stainless steel.
    - 5. Normally closed.
    - 6. Visual position indicator.
    - 7. Electrical actuator operated by appliance automatic shutoff device.
  - B. Electrically Operated Valves: Comply with UL 429.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. American Gas Safety, LLC.
      - b. Eclipse Innovative Thermal Technologies.
      - c. Goyen Valve Corp.
    - 2. Pilot operated.
    - 3. Body: Brass or aluminum.
    - 4. Seats and Disc: NBR.

5. Springs and Valve Trim: Stainless steel.
6. 120 V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

## 2.8 EARTHQUAKE VALVES

- A. Earthquake Valves, Maximum Operating Pressure of 5 psig (34.5 kPa): Comply with ASCE/SEI 25.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Firefighter Gas Safety Products.
    - b. Pacific Seismic Products, Inc.
  2. Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  3. Maximum Operating Pressure: 5 psig.
  4. Cast-aluminum body with nickel-plated chrome steel internal parts.
  5. NBR valve washer.
  6. Sight windows for visual indication of valve position.
  7. Threaded end connections complying with ASME B1.20.1.
  8. Wall-mounting bracket with bubble level indicator.
- B. Earthquake Valves, Maximum Operating Pressure of 60 psig (414 kPa): Comply with ASCE/SEI 25.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Pacific Seismic Products, Inc.
  2. Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  3. Maximum Operating Pressure: 60 psig.
  4. Cast-aluminum body with stainless steel internal parts.
  5. NBR, reset-stem O-ring seal.
  6. Valve position, open or closed, indicator.
  7. Composition valve seat with clapper held by spring or magnet locking mechanism.
  8. Level indicator.
  9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

## 2.9 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural gas.
  2. Steel jacket and corrosion-resistant components.
  3. Elevation compensator.
  4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Service Pressure Regulators: Comply with ANSI Z21.80A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Meter Company.
    - b. Fischer; Emerson Electric Co., Automation Solutions.
    - c. Schneider Electric USA, Inc.
  2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  3. Springs: Zinc-plated steel; interchangeable.
  4. Diaphragm Plate: Zinc-plated steel.
  5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
  6. Orifice: Aluminum; interchangeable.
  7. Seal Plug: UV-stabilized, mineral-filled nylon.
  8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
  9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
  10. Overpressure Protection Device: Factory mounted on pressure regulator.
  11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 100 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80A.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Meter Company.
    - b. Fischer; Emerson Electric Co., Automation Solutions.



- c. Schneider Electric USA, Inc.
    2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
    3. Springs: Zinc-plated steel; interchangeable.
    4. Diaphragm Plate: Zinc-plated steel.
    5. Seat Disc: NBR; resistant to gas impurities, abrasion, and deformation at the valve port.
    6. Orifice: Aluminum; interchangeable.
    7. Seal Plug: UV-stabilized, mineral-filled nylon.
    8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to regulator.
    9. Pressure regulator is to maintain discharge pressure setting downstream and is to not exceed 150 percent of design discharge pressure at shutoff.
    10. Overpressure Protection Device: Factory mounted on pressure regulator.
    11. Atmospheric Vent: Factory- or field-installed, stainless steel screen in opening if not connected to vent piping.
    12. Maximum Inlet Pressure: 2 psig.
  - D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. Canadian Meter Company, LLC; a Honeywell Company.
      - b. Dormont; A Watts Water Technologies Company.
      - c. Eaton.
    2. Body and Diaphragm Case: Die-cast aluminum.
    3. Springs: Zinc-plated steel; interchangeable.
    4. Diaphragm Plate: Zinc-plated steel.
    5. Seat Disc: NBR.
    6. Seal Plug: UV-stabilized, mineral-filled nylon.
    7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
    8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
    9. Maximum Inlet Pressure: 1 psig.
- 2.10 SERVICE METERS
  - A. Diaphragm-Type Service Meters: Comply with ANSI B109.1 ANSI B109.2.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. Actaris: a brand of ITT Controls.
      - b. American Meter Company.
      - c. Schneider Electric USA, Inc.
    2. Case: Die-cast aluminum.
    3. Connections: Steel threads.
    4. Diaphragm: Synthetic fabric.
    5. Diaphragm Support Bearings: Self-lubricating.
    6. Compensation: Continuous temperature and pressure.
    7. Meter Index: Cubic feet.
    8. Meter Case and Index: Tamper resistant.
    9. Remote meter reader compatible.
    10. Maximum Inlet Pressure: 100 psig.
    11. Pressure Loss: Maximum 0.5 inch wg.
    12. Accuracy: Maximum plus or minus 1.0 percent.
  - B. Rotary-Type Service Meters: Comply with ANSI B109.3.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. American Meter Company.
      - b. Schneider Electric USA, Inc.
    2. Case: Extruded aluminum.
    3. Connection: Flange.
    4. Impellers: Polished aluminum.
    5. Rotor Bearings: Self-lubricating.
    6. Compensation: Continuous temperature and pressure.
    7. Meter Index: Cubic feet.

8. Tamper resistant.
  9. Remote meter reader compatible.
  10. Maximum Inlet Pressure: 100 psig.
  11. Accuracy: Maximum plus or minus 2.0 percent.
- C. Turbine Meters: Comply with ASME MFC-4M.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Meter Company.
    - b. Schneider Electric USA, Inc.
  2. Housing: Cast iron or welded steel.
  3. Connection Threads or Flanges: Steel.
  4. Turbine: Aluminum or plastic.
  5. Turbine Bearings: Self-lubricating.
  6. Compensation: Continuous temperature and pressure.
  7. Meter Index: Cubic feet.
  8. Tamper resistant.
  9. Remote meter reader compatible.
  10. Maximum Inlet Pressure: 100 psig.
  11. Accuracy: Maximum plus or minus 2.0 percent.
- D. Service-Meter Bars:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. American Meter Company.
    - c. Mueller Co. LLC; Mueller Water Products, Inc.
  2. Malleable- or cast-iron frame for supporting service meter.
  3. Include offset swivel pipes, meter nuts with O-ring seal, and factory- or field-installed dielectric unions.
  4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.
- E. Service-Meter Bypass Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. R.W. Lyall; brand of Hubbell Utility Solutions; Hubbell Incorporated.
    - b. Williamson, T. D., Inc.
  2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
  3. Integral ball-check bypass valve.
- 2.11 DIELECTRIC FITTINGS
- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Wilkins.
    - c. Zurn Industries, LLC.
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 125 psig minimum at 180 deg F.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Capitol Manufacturing Company.
    - b. WATTS; A Watts Water Technologies Company.
    - c. Wilkins.
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 125 psig minimum at 180 deg F.

- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  - D. Dielectric-Flange Insulating Kits:
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      - a. Advance Products & Systems, LLC.
      - b. CALPICO, Inc.
      - c. GF Piping Systems: Georg Fischer LLC.
    2. Description:
      - a. Nonconducting materials for field assembly of companion flanges.
      - b. Pressure Rating: 150 psig.
      - c. Gasket: Neoprene or phenolic.
      - d. Bolt Sleeves: Phenolic or polyethylene.
      - e. Washers: Phenolic with steel backing washers.
- 2.12 LABELING AND IDENTIFYING
- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description and rated pressure of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.
  - B. Label and identify gas piping and pressure outside a multitenant building by tenant.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping in accordance with NFPA 54 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 the International Fuel Gas Code requirements for preventing accidental ignition.

#### **3.3 INSTALLATION OF OUTDOOR PIPING**

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.
  1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping in accordance with ASTM D2774.
- D. Steel Piping with Protective Coating:
  1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
  1. Apply joint cover kits over tubing to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Install pressure gauge downstream from each service regulator. Pressure gauges are specified in Section 23 05 00 "Common Work Results for HVAC."

### 3.4 INSTALLATION OF INDOOR PIPING

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Do not install piping in concealed locations unless sleeved with the sleeve open at both ends.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Where installing piping above accessible ceilings, allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access. Do not locate valves within return air plenums.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
  - 2. Install sediment trap on both sides of regulators for gas reduction to 2 psig with valve and cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
  - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
  - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
  - 5. Prohibited Locations:
    - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

- T. Do not use natural-gas piping as grounding electrode.
  - U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
  - V. Install pressure gauge downstream from each line regulator. Pressure gauges are specified in Section 23 05 00 "Common Work Results for HVAC."
  - W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 00 "Common Work Results for HVAC."
  - X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 00 "Common Work Results for HVAC."
  - Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 00 "Common Work Results for HVAC."
- 3.5 INSTALLATION OF SERVICE-METER ASSEMBLIES
- A. Install service-meter assemblies aboveground, on concrete bases.
  - B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
  - C. Install strainer on inlet of service-pressure regulator and meter set.
  - D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
  - E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
  - F. Install service meters downstream from pressure regulators.
  - G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 05 50 00 "Metal Fabrications" for pipe bollards.
- 3.6 INSTALLATION OF VALVES
- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless steel tubing, aluminum, or copper connector.
  - B. Install underground valves with valve boxes.
  - C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
  - D. Install earthquake valves aboveground outside buildings according to listing.
  - E. Install anode for metallic valves in underground PE piping.
  - F. Do not install valves in return-air plenums.
- 3.7 PIPING JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs.
  - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - C. Threaded Joints:
    - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
    - 2. Cut threads full and clean using sharp dies.
    - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
    - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
    - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  - D. Welded Joints:
    - 1. Construct joints in accordance with AWS D10.12/D10.12M, using qualified processes and welding operators.
    - 2. Bevel plain ends of steel pipe.
    - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
  - E. Brazed Joints: Construct joints in accordance with AWS's "Braze Handbook," "Pipe and Tube" Chapter.

- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
  - G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, and then use wrench. Do not overtighten.
  - H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.
    - 1. Plain-End Pipe and Fittings: Use butt fusion.
    - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- 3.8 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
  - B. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
  - C. Install hangers for steel piping and copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - D. Install hangers for corrugated stainless steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - E. Support horizontal piping within 12 inches of each fitting.
  - F. Support vertical runs of steel piping and copper tubing to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - G. Support vertical runs of corrugated stainless steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- 3.9 PIPING CONNECTIONS
- A. Connect to utility's gas main according to utility's procedures and requirements.
  - B. Install natural-gas piping electrically continuous, and bonded to gas-appliance equipment grounding conductor of the circuit powering the appliance in accordance with NFPA 70.
  - C. Where installing piping adjacent to appliances, allow space for service and maintenance of appliances.
  - D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- 3.10 LABELING AND IDENTIFICATION
- A. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for piping and valve identification.
  - B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- 3.11 CONCRETE BASES
- A. Concrete Bases: Anchor equipment to concrete base.
    - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
    - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
    - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
    - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
    - 6. Use 3000 psig, 28-day, compressive-strength concrete and reinforcement as specified in Section 03 30 00 "Cast-in-Place Concrete."

3.12 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas in accordance with NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.
  - 2. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.14 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping is to be one of the following:
  - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
  - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
  - 3. Drawn]-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
  - 4. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping is to be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
  - 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

- A. Aboveground, branch piping NPS 1 and smaller is to be one of the following:
  - 1. Corrugated stainless steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  - 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  - 3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
  - 4. Aluminum tube with flared fittings and joints.
  - 5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping is to be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
  - 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Underground, below building, piping is to be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
  - 3. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
  - 4. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

- A. Aboveground, branch piping NPS 1 and smaller is to be one of the following:
  - 1. Corrugated stainless steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  - 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
  - 4. Aluminum tube with flared fittings and joints.
  - 5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping is to be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with steel welding fittings and welded joints.

3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
  - C. Underground, below building, piping is to be one of the following:
    1. Steel pipe with malleable-iron fittings and threaded joints.
    2. Steel pipe with wrought-steel fittings and welded joints.
    3. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.
    4. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.
- 3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG (34.5 kPa)
- A. Aboveground Piping: Maximum operating pressure more than 5 psig.
  - B. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.
  - C. Aboveground, distribution piping is to be one of the following:
    1. Steel pipe with steel welding fittings and welded joints.
    2. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
  - D. Underground, below building, piping is to be one of the following:
    1. Steel pipe with malleable-iron fittings and threaded joints.
    2. Steel pipe with wrought-steel fittings and welded joints.
    3. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
    4. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.
- 3.18 UNDERGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
  - B. Underground:
    1. PE valves.
    2. NPS 2 (DN 50) and Smaller: Bronze plug valves.
    3. NPS 2-1/2 (DN 65) and Larger: Cast-iron, lubricated plug valves.
- 3.19 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Valves for pipe sizes NPS 2 and smaller at service meter are to be one of the following:
    1. One-piece, bronze ball valve with bronze trim.
    2. Two-piece, full-port, bronze ball valves with bronze trim.
    3. Bronze plug valve.
  - B. Valves for pipe sizes NPS 2-1/2 and larger at service meter are to be one of the following:
    1. Two-piece, full-port, bronze ball valves with bronze trim.
    2. Bronze plug valve.
    3. Cast-iron, nonlubricated plug valve.
  - C. Distribution piping valves for pipe sizes NPS 2 and smaller are to be one of the following:
    1. One-piece, bronze ball valve with bronze trim.
    2. Two-piece, full-port, bronze ball valves with bronze trim.
    3. Bronze plug valve.
  - D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger are to be one of the following:
    1. Two-piece, full-port, bronze ball valves with bronze trim.
    2. Bronze plug valve.
    3. Cast-iron, nonlubricated lubricated plug valve.
  - E. Valves in branch piping for single appliance are to be one of the following:
    1. One-piece, bronze ball valve with bronze trim.
    2. Two-piece, full-port, bronze ball valves with bronze trim.
    3. Bronze plug valve.

END OF SECTION 23 11 23



## SECTION 23 22 13

### STEAM AND CONDENSATE PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel pipe and fittings.
  - 2. Stainless steel pipe and fittings.
  - 3. Fiberglass pipe and fittings.
  - 4. Joining materials.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated Design Submittals:
  - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
  - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Other building services.
  - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Fiberglass Pipe and Fitting Installers: Installers of fiberglass pipe and fittings shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to the following:
  - 1. ASME Compliance: Comply with ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
  - 1. Condensate Piping: 20 psig at 250 deg F.

2. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
3. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

## 2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.
- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.
- E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.
- G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  1. Material Group: 1.1.
  2. End Connections: Butt welding.
  3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

## 2.3 STAINLESS STEEL PIPE AND FITTINGS

- A. Stainless Steel Pipe: ASTM A312/A312M, plain ends, seamless; stainless steel of types and schedules as indicated in piping application articles.
- B. Stainless Steel Socket Weld Fittings: Stainless steel, wrought or forged, of types and classes as indicated in piping application articles.
- C. Stainless Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, wrought, raised face weld neck, including gaskets, bolts, and nuts of material to match pipe.

## 2.4 FIBERGLASS PIPE AND FITTINGS

- A. Reinforced Thermosetting Resin Pressure Pipe (RTRP): ASTM D2996, Type 1, Grade 1, Class F, filament-wound pipe with tapered bell and spigot ends for adhesive joints.
- B. Glass-Fiber-Reinforced Thermosetting-Resin: ASTM D5685, Type 2 or Type 5, Grade 1, Class F, compression or spray-up/contact molded fittings of same material, pressure class, and joining method as pipe.
- C. Flanges: ASTM D4024, Type 1, Grade 1, full-face gaskets suitable for the service, minimum 1/8 inch thick, 60-70 durometer. ASTM A307, Grade B, hex head bolts with washers.

## 2.5 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face flanges.
    - b. Narrow-Face Type: For raised-face flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel of type to match pipe unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

- E. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF PIPING**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to top of main pipe.
- P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping" or other Sections as needed.
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.
- T. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- U. Comply with requirements in Section 23 05 00 "Common Work Results for HVAC" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- V. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.
- W. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
  - 1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 ft..
  - 2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 00 "Common Work Results for HVAC."
- Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 00 "Common Work Results for HVAC."

- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 00 "Common Work Results for HVAC."
- 3.2 INSTALLATION OF STEAM AND CONDENSATE PIPING SPECIALTIES
- A. Comply with requirements in Section 23 22 16 "Steam and Condensate Heating Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.
- 3.3 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for seismic restraints in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
  - B. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers, supports, and anchor devices.
  - C. Install the following pipe attachments:
    - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 ft. long.
    - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 ft. or longer.
    - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. or longer, supported on a trapeze.
    - 4. Spring hangers to support vertical runs.
  - D. Install hangers for steel steam supply piping and steel steam condensate piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - E. Install hangers for fiberglass piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - F. Support horizontal piping within 12 inches of each fitting.
  - G. Support vertical runs of steel steam supply piping and steel steam condensate piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
  - H. Support vertical runs of fiberglass piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- 3.4 PIPE JOINT CONSTRUCTION
- A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.
  - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  - D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
  - F. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- 3.5 TERMINAL EQUIPMENT CONNECTIONS
- A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
  - B. Install traps and control valves in accessible locations close to connected equipment.
  - C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

- D. Install vacuum breakers downstream from control valve, close to coil inlet connection.
- E. Install a drip leg at coil outlet.

3.6 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush system with clean water. Clean strainers.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - 2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
  - 3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
- E. Prepare test and inspection reports.

END OF SECTION 23 22 13

**SECTION 23 23 00**  
**REFRIGERANT PIPING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Steel pipe and fittings.
  - 3. Valves and specialties.
  - 4. Refrigerants.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Hot-gas bypass valves.
  - 4. Strainers.
  - 5. Filter dryers.
  - 6. Pressure-regulating valves.
  - 7. Mufflers.
- B. Product Data Submittals: For each product.
  - 1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.
- C. Delegated Design Submittals: For refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- D. Shop Drawings:
  - 1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
  - 2. Show interface and spatial relationships between piping and equipment.
  - 3. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: For each welder performing shop or field welding on Project.
- B. Field Quality-Control Reports: For each field quality control test and inspection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding, Brazing, and Fusing Qualifications."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.
- B. Prepare valves and specialties for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads and other end connections.
- C. Use the following precautions during storage:
  - 1. Maintain valve and specialty end protection.

2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," for refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- B. Comply with ASHRAE 15.
- C. Comply with ASME B31.5.
- D. Test Pressure for Refrigerant R-410A and R-32:
  1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig.
  2. Suction Tubing for Heat-Pump Applications: 535 psig.
  3. Hot-Gas and Tubing Lines: 535 psig.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B88, Type K or L ASTM B280, Type ACR.
- B. Wrought-Copper Fittings, Solder Joint: ASME B16.22.
- C. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- F. Brazing Filler Metals: AWS A5.8M/A5.8.
- G. Flexible Connectors:
  1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  2. End Connections: Socket ends.
  3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  4. Working Pressure Rating: Factory test at minimum 500 psig.
  5. Maximum Operating Temperature: 250 deg F.
- H. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Conex Banninger - USA.
    - b. Mueller Streamline Co.; a company of Mueller Industries.
    - c. Parker Hannifin; Sporlan Division (Zoomlock).
  2. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
  3. Housing: Copper.
  4. O-Rings: HNBR compatible with specific refrigerant.
  5. Tools: Manufacturer's approved special tools.
  6. Minimum Rated Pressure: 700 psig.

### **2.3 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; type, grade, and wall thickness as selected in piping application articles.
- B. Wrought-Steel Fittings: ASTM A234/A234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5 steel, including bolts, nuts, gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 and ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

- E. Flanged Unions:
  - 1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Factory apply rust-resistant finish.
  - 2. Gasket: Fiber asbestos free.
  - 3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Factory apply rust-resistant finish.
  - 4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
  - 5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 6. Pressure Rating: Factory test at minimum 400 psig.
  - 7. Maximum Operating Temperature: 330 deg F.
- F. Flexible Connectors:
  - 1. Body: Stainless steel bellows with woven, flexible, stainless steel-wire-reinforced protective jacket.
  - 2. End Connections:
    - a. NPS 2 (DN 50) and Smaller: With threaded-end connections.
    - b. NPS 2-1/2 (DN 65) and Larger: With flanged-end connections.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

## 2.4 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  - 2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  - 3. Diaphragm: Phosphor bronze and stainless steel with stainless steel spring.
  - 4. Operator: Rising stem and hand wheel.
  - 5. Seat: Nylon.
  - 6. End Connections: Socket, union, or flanged.
  - 7. Working Pressure Rating: 500 psig.
  - 8. Maximum Operating Temperature: 240 deg F.
- B. Packed-Angle Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  - 2. Body and Bonnet: Forged brass or cast bronze.
  - 3. Packing: Molded stem, back seating, and replaceable under pressure.
  - 4. Operator: Rising stem.
  - 5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
  - 6. Seal Cap: Forged-brass or valox hex cap.
  - 7. End Connections: Socket, union, threaded, or flanged.
  - 8. Working Pressure Rating: 500 psig.
  - 9. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. Danfoss, Inc.
    - c. Emerson Climate Technologies; Emerson Electric Co.
  - 2. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
  - 3. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
  - 4. Piston: Removable polytetrafluoroethylene seat.
  - 5. Closing Spring: Stainless steel.
  - 6. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
  - 7. End Connections: Socket, union, threaded, or flanged.
  - 8. Maximum Opening Pressure: 0.50 psig.
  - 9. Working Pressure Rating: 500 psig.
  - 10. Maximum Operating Temperature: 275 deg F.



- D. Service Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body: Forged brass with brass cap, including key end to remove core.
  3. Core: Removable ball-type check valve with stainless steel spring.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Copper spring.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg F.
- E. Refrigerant Locking Caps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & D Valve, LLC.
    - b. JB Industries.
    - c. RectorSeal HVAC; a CSW Industrials Company.
  2. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
  3. Material: Brass, with protective shroud or sleeve.
  4. Refrigerant Identification: Color-coded, refrigerant specific based on AHRI Guideline N or Universal design.
  5. Special Tool: For installing and unlocking.
- F. Solenoid Valves: Comply with AHRI 760 I-P and UL 429; listed and labeled by an NRTL.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body and Bonnet: Plated steel.
  3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Threaded.
  6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24 V ac coil.
  7. Working Pressure Rating: 400 psig.
  8. Maximum Operating Temperature: 240 deg F.
- G. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  3. Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Seat: Polytetrafluoroethylene.
  5. End Connections: Threaded.
  6. Working Pressure Rating: 400 psig.
  7. Maximum Operating Temperature: 240 deg F.
- H. Thermostatic Expansion Valves: Comply with AHRI 750 I-P.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body, Bonnet, and Seal Cap: Forged brass or steel.
  3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Packing and Gaskets: Non-asbestos.
  5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  6. Suction Temperature: 40 deg F.
  7. Superheat: Adjustable.
  8. Reverse-flow option (for heat-pump applications).
  9. End Connections: Socket, flare, or threaded union.

10. Working Pressure Rating: 700 psig.
- I. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  2. Body, Bonnet, and Seal Cap: Ductile iron or steel.
  3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  4. Packing and Gaskets: Non-asbestos.
  5. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  6. Seat: Polytetrafluoroethylene.
  7. Equalizer: Internal.
  8. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter and 24 V ac coil.
  9. End Connections: Socket.
  10. Set Pressure: .
  11. Throttling Range: Maximum 5 psig.
  12. Working Pressure Rating: 500 psig.
  13. Maximum Operating Temperature: 240 deg F.
- J. Straight-Type Strainers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  2. Body: Welded steel with corrosion-resistant coating.
  3. Screen: 100-mesh stainless steel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig.
  6. Maximum Operating Temperature: 275 deg F.
- K. Angle-Type Strainers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  2. Body: Forged brass or cast bronze.
  3. Drain Plug: Brass hex plug.
  4. Screen: 100-mesh monel.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg F.
- L. Moisture/Liquid Indicators:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body: Forged brass.
  3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  4. Indicator: Color-coded to show moisture content in parts per million (ppm).
  5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  6. End Connections: Socket or flare.
  7. Working Pressure Rating: 500 psig.
  8. Maximum Operating Temperature: 240 deg F.
- M. Replaceable-Core Filter Dryers: Comply with AHRI 730 I-P.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body and Cover: Painted-steel shell with ductile-iron cover, stainless steel screws, and neoprene gaskets.
  3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.

4. Desiccant Media: Activated charcoal.
  5. Design: Reverse flow (for heat-pump applications).
  6. End Connections: Socket.
  7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
  8. Maximum Pressure Loss: 2 psig.
  9. Rated Flow: .
  10. Working Pressure Rating: 500 psig.
  11. Maximum Operating Temperature: 240 deg F.
- N. Permanent Filter Dryers: Comply with AHRI 730 I-P.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body and Cover: Painted-steel shell.
  3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.
  4. Desiccant Media: Activated charcoal.
  5. Design: Reverse flow (for heat-pump applications).
  6. End Connections: Socket.
  7. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
  8. Maximum Pressure Loss: 2 psig.
  9. Rated Flow: .
  10. Working Pressure Rating: 500 psig.
  11. Maximum Operating Temperature: 240 deg F.
- O. Mufflers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Danfoss, Inc.
    - b. Emerson Climate Technologies; Emerson Electric Co.
    - c. Henry Technologies Inc.; The Henry Group.
  2. Body: Welded steel with corrosion-resistant coating.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig.
  5. Maximum Operating Temperature: 275 deg F.
- P. Receivers: Comply with AHRI 495.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Henry Technologies Inc.; The Henry Group.
    - b. Parker Hannifin; Sporlan Division (Zoomlock).
  2. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  3. Comply with UL 207; listed and labeled by an NRTL.
  4. Body: Welded steel with corrosion-resistant coating.
  5. Tappings: Inlet, outlet, liquid-level indicator, and safety-relief valve.
  6. End Connections: Socket or threaded.
  7. Working Pressure Rating: 450 psig.
  8. Maximum Operating Temperature: 250 deg F.
- Q. Liquid Accumulators: Comply with AHRI 495.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Emerson Climate Technologies; Emerson Electric Co.
    - b. Henry Technologies Inc.; The Henry Group.
    - c. Parker (Parker Hannifin).
  2. Body: Welded steel with corrosion-resistant coating.
  3. End Connections: Socket or threaded.
  4. Working Pressure Rating: 500 psig.
  5. Maximum Operating Temperature: 275 deg F .

## 2.5 REFRIGERANTS

- A. R-410A, ASHRAE 34: Pentafluoroethane/Difluoromethane.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arkema Inc.
    - b. DuPont Fluorochemicals Div.

- c. Genetron Refrigerants; Honeywell International Inc.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATION SCHEDULES**

- A. Refrigerant: R-410A
- B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- C. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 4 (DN 100) and Smaller: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- D. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 2 to NPS 4 (DN 50 to DN 100): Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- E. Safety-Relief-Valve Discharge Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, Copper: Type K or Type L, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- F. Safety-Relief-Valve Discharge Piping for Conventional Air-Conditioning (Cooling-Only) Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.
- G. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.
- H. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 4 (DN 100) and Smaller: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- I. Suction, Hot-Gas, and Liquid Tubing for Heat-Pump Applications, NPS 2 to NPS 4 (DN 50 to DN 100): Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- J. Safety-Relief-Valve Discharge Tubing for Heat-Pump Applications, Copper: Type K or Type L, drawn-temper or annealed-temper tubing and wrought-copper fittings with brazed or soldered joints
- K. Safety-Relief-Valve Discharge Piping for Heat-Pump Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.

#### **3.2 VALVE AND SPECIALTY APPLICATIONS**

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-size, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety-relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside in accordance with ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Hot-gas bypass valves.
  - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.
- N. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

### 3.3 INSTALLATION OF PIPING, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping in accordance with ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
  - 1. Shot blast the interior of piping.
  - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
  - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.

5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
  6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Identify refrigerant piping and valves in accordance with Section 23 05 53 "Identification for HVAC Piping and Equipment."
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 00 "Common Work Results for HVAC."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 00 "Common Work Results for HVAC."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 00 "Common Work Results for HVAC."
- 3.4 PIPE JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."
1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
  2. Use Type BA<sub>g</sub> (cadmium-free silver) alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 3.5 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for seismic restraints in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- B. Comply with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. long.
  2. Roller hangers and spring hangers for individual horizontal runs 20 ft. or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of copper tubing and steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System must maintain test pressure at the manifold gauge throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- C. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
  - 1. Install core in filter dryers after leak test but before evacuation.
  - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, in accordance with manufacturer's written instructions:
  - 1. Open shutoff valves in condenser water circuit.
  - 2. Verify that compressor oil level is correct.
  - 3. Open compressor suction and discharge valves.
  - 4. Open refrigerant valves but not bypass valves that are used for other purposes.
  - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

## SECTION 23 31 13

### METAL DUCTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Double-wall rectangular ducts and fittings.
  - 3. Single-wall round ducts and fittings.
  - 4. Double-wall round ducts and fittings.
  - 5. Sheet metal materials.
  - 6. Duct liner.
  - 7. Sealants and gaskets.
  - 8. Hangers and supports.
- B. Related Requirements:
  - 1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

##### 1.2 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning and Development (State of California).

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
  - 3. Seismic-restraint devices.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top and bottom of ducts.
  - 5. Dimensions of all duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
  - 13.
- C. Delegated Design Submittals:
  - 1. Sheet metal thicknesses.
  - 2. Joint and seam construction and sealing.
  - 3. Reinforcement details and spacing.
  - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
  - 5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.



1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  - 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Mockups:
  - 1. Before installing duct systems, build mockups representing static-pressure classes in excess of 3 inch wg. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
    - a. Five transverse joints.
    - b. One access door(s).
    - c. Two typical branch connections, each with at least one elbow.
    - d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.
    - e. One 90-degree turn(s) with turning vanes.
    - f. One fire damper(s).
    - g. One smoke damper(s).
    - h. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Seismic Performance: Ductwork to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 23 05 48 "Vibration and Seismic Controls for HVAC."
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  - 2. Component Importance Factor: 1.5.
  - 3.
- D. Wind Performance: Ducts are to withstand the effects of wind determined in accordance with to ASCE/SEI 7. See Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- E. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- G. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- H. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

## 2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
  - 3. Where specified for specific applications, all joints are to be welded.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Where specified for specific applications, all joints are to be welded.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. <Double click here to find, evaluate, and insert list of manufacturers and products.>
- B. Source Limitations: Obtain double-wall rectangular ducts and fittings from single manufacturer.
- C. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- E. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
  - 3. Where specified for specific applications, all joints are to be welded.
- F. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Where specified for specific applications, all joints are to be welded.
- G. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  - 3. Coat insulation with antimicrobial coating.
  - 4. Cover insulation with polyester film complying with UL 181, Class 1.

- H. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
  - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- I. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

#### 2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
  - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GreenSeam.
    - b. Nordfab Ducting.
    - c. Ductmate Industries, Inc; a DMI company.
- B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- F. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

#### 2.5 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. MKT Metal Manufacturing.
  - 2. SEMCO, LLC; part of FlaktGroup.
  - 3. Set Duct Manufacturing.
- B. Source Limitations: Obtain double-wall round ducts and fittings from single manufacturer.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. For ducts exposed to weather, construct outer duct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
  - 3. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

4. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
  5. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - E. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
  - F. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
    1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
    3. Coat insulation with antimicrobial coating.
    4. Cover insulation with polyester film complying with UL 181, Class 1.
  - G. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
    1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- 2.6 SHEET METAL MATERIALS
- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
  - B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
    1. Galvanized Coating Designation: G90.
    2. Finishes for Surfaces Exposed to View: Mill phosphatized.
  - C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.
    1. Galvanized Coating Designation: G90.
    2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
    3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
  - D. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
  - E. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
  - F. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
  - G. Factory- or Shop-Applied Antimicrobial Coating:
    1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
    2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
    3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
    4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
    5. Shop-Applied Coating Color: Black.
    6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

- H. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- I. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

## 2.7 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Owens Corning.
  - 2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
  - 3. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 5. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
  - 2. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.
  - 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- C. Fibrous-Glass-Free, Natural-Fiber Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acoustical Surfaces, Inc.
    - b. Ductmate Industries, Inc; a DMI company.
  - 2. Source Limitations: Obtain fibrous-glass-free, natural-fiber duct liner from single manufacturer.
  - 3. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
  - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
  - 5. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- D. Polyolefin Duct Liner: Cross-linked, partially open-cell polyolefin foam sheet or roll materials, with reinforced aluminum foil facing and adhesive backing, complying with NFPA 90A or NFPA 90B; sheet (Type II) complying with ASTM C1427.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Sekisui Voltek, LLC.
  - 2. Source Limitations: Obtain polyolefin duct liner from single manufacturer.
  - 3. Foam Core Density: 1.5 pcf.
  - 4. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
  - 5. Minimum Noise Reduction Coefficient (NRC): 0.50 for 3/8-inch thickness, 0.45 for 5/8-inch thickness, 0.55 for 1-inch thickness, 0.55 for 2-1/8-inch thickness.

6. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  7. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- E. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
  9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
  10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.
- 2.8 SEALANT AND GASKETS
- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 3 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  9. Service: Indoor or outdoor.
  10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
- 2.9 HANGERS AND SUPPORTS
- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### **PART 3 - EXECUTION**

#### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- N. Branch Connections: Use lateral or conical branch connections.

#### **3.2 INSTALLATION OF EXPOSED DUCTWORK**

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

#### **3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT**

- A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.
- B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.



- C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be stainless steel as per "Duct Schedule" Article.
  - D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.
  - E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.
  - F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- 3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS
- A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.
  - B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.
  - C. Minimize number of transverse seams.
  - D. Do not locate longitudinal seams on bottom of duct.
- 3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS
- A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."
  - B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.
  - C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.
- 3.6 DUCTWORK EXPOSED TO WEATHER
- A. All external joints are to be welded. Seal all openings to provide weatherproof construction.
  - B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
  - C. Single Wall:
    - 1. Ductwork is to be Type 304 stainless steel.
    - 2. Ductwork is to be galvanized steel.
      - a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting."
    - 3. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 23 07 13 "Duct Insulation."
  - D. Double Wall:
    - 1. Ductwork complies with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall Round Ducts and Fittings" Article.
    - 2. Ductwork outer wall is to be Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
    - 3. Provide interstitial insulation.
- 3.7 DUCT SEALING
- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
    - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - 2. Outdoor, Supply-Air Ducts: Seal Class A.
    - 3. Outdoor, Exhaust Ducts: Seal Class C.
    - 4. Outdoor, Return-Air Ducts: Seal Class C.
    - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
    - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
    - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
    - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
    - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 23 05 48 "Vibration and Seismic Controls for HVAC."
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.9 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. See Section 23 05 48 "Vibration and Seismic Controls for HVAC" for seismic restraint installation requirements.

### 3.10 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.11 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
    - b. Supply Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - c. Return Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

- d. Exhaust Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      - e. Outdoor-Air Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
    3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
    4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
    5. Test for leaks before applying external insulation.
    6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
    7. Give seven days' advance notice for testing.
  - C. Duct System Cleanliness Tests:
    1. Visually inspect duct system to ensure that no visible contaminants are present.
    2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.
  - D. Duct system will be considered defective if it does not pass tests and inspections.
  - E. Prepare test and inspection reports.
- 3.13 DUCT CLEANING
  - A. Clean new duct system(s) before testing, adjusting, and balancing.
  - B. For cleaning of existing ductwork, see Section 23 01 30.52 "Existing HVAC Air Distribution System Cleaning."
  - C. Use duct cleaning methodology as indicated in NADCA ACR.
  - D. Use service openings for entry and inspection.
    1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
    2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
    3. Remove and reinstall ceiling to gain access during the cleaning process.
  - E. Particulate Collection and Odor Control:
    1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
    2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
  - F. Clean the following components by removing surface contaminants and deposits:
    1. Air outlets and inlets (registers, grilles, and diffusers).
    2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
    3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
    4. Coils and related components.
    5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
    6. Supply-air ducts, dampers, actuators, and turning vanes.
    7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.14 STARTUP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.15 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
2. Underground Ducts: Concrete-encased, galvanized sheet steel.

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
2. Ducts Connected to Constant-Volume Air-Handling Units:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
  - a. Pressure Class: Positive 3-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
4. Ducts Connected to Equipment Not Listed Above:
  - a. Pressure Class: Positive 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.

- C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
  - a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
2. Ducts Connected to Air-Handling Units:
  - a. Pressure Class: Positive or negative 3- Insert numberinch wg.
  - b. Minimum SMACNA Seal Class: A.
  - c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
3. Ducts Connected to Equipment Not Listed above:
  - a. Pressure Class: Positive or negative 2-inch wg.
  - b. Minimum SMACNA Seal Class: A.

- c. SMACNA Leakage Class for Rectangular: 2.
  - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- D. Exhaust Ducts:
- 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 2.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 2.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  - 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
    - a. Exposed to View: Type 304, stainless steel sheet, No. 4 finish.
    - b. Concealed: Type 304, stainless steel sheet, No. 2D finish.
    - c. Welded seams and joints.
    - d. Pressure Class: Positive or negative 2-inch wg.
    - e. Airtight/watertight.
  - 4. Ducts Connected to Dishwashers, Dishwasher Hoods, and Other High-Humidity Locations:
    - a. Type 304, stainless steel sheet.
    - b. Exposed to View: No. 4 finish.
    - c. Concealed: No. 2D finish.
    - d. Welded longitudinal seams; welded or flanged transverse joints with watertight EPDM gaskets.
    - e. Pressure Class: Positive or negative 2-inch wg.
    - f. Airtight/watertight.
  - 5. Ducts Connected to Fans Exhausting Fume Hood, Laboratory, and Process (ASHRAE 62.1, Class 3 and Class 4) Air:
    - a. Type 304, stainless steel sheet.
      - 1) Exposed to View: No. 4 finish.
      - 2) Concealed: No. 2B finish.
    - b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
    - c. Pressure Class: Positive or negative 3-inch wg.
    - d. Minimum SMACNA Seal Class A.
    - e. SMACNA Leakage Class 2.
    - f. Airtight/watertight.
  - 6. Ducts Connected to Equipment Not Listed above:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure; A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 2.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
- 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 2.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 2.
    - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- F. Intermediate Reinforcement:
- 1. Galvanized-Steel Ducts: Galvanized steel.

2. PVC-Coated Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
  3. Stainless Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
  4. Aluminum Ducts: Aluminum galvanized steel coated with zinc chromate.
- G. Liner:
1. Supply-Air Ducts: Fibrous glass, Type I, 1 inch thick.
  2. Return-Air Ducts: Fibrous glass, Type I, 1 inch thick.
  3. Exhaust-Air Ducts: Fibrous glass, Type I, 1 inch thick.
  4. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.
  5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 1 inches thick.
  6. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
- H. Double-Wall Duct Interstitial Insulation:
1. Supply-Air Ducts: 1 inch thick.
  2. Return-Air Ducts: 1 inch thick.
  3. Exhaust-Air Ducts: 1 inch thick.
- I. Elbow Configuration:
1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 4) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

- J. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Conical spin in.
  2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
    - a. Velocity 1000 fpm or Lower: 90-degree tap.
    - b. Velocity 1000 to 1500 fpm: Conical tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

## SECTION 23 33 00

### AIR DUCT ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Backdraft and pressure relief dampers.
  2. Barometric relief dampers.
  3. Manual volume dampers.
  4. Control dampers.
  5. Fire dampers.
  6. Ceiling radiation dampers.
  7. Smoke dampers.
  8. Combination fire and smoke dampers.
  9. Corridor dampers.
  10. Flange connectors.
  11. Duct silencers.
  12. Turning vanes.
  13. Remote damper operators.
  14. Duct-mounted access doors.
  15. Duct access panel assemblies.
  16. Flexible connectors.
  17. Duct security bars.
  18. Duct accessory hardware.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.
1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control-damper installations.
    - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Duct security bars.
    - f. Include diagrams for power, signal, and control wiring.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.
- B. Source quality-control reports.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.



1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  - 3. Safe Air - Dowco.
- B. Description: Gravity balanced.
- C. Performance:
  - 1. Maximum Air Velocity: 1250 fpm.
  - 2. Maximum System Pressure: 2 inches wg.
  - 3. AMCA Certification: Test and rate in accordance with AMCA 511.
  - 4. Leakage:
    - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
    - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
    - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
    - d. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.
- D. Construction:
  - 1. Frame:
    - a. Hat shaped.
    - b. 16-gauge-thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
  - 2. Blades:
    - a. Multiple single-piece blades.
    - b. Center pivoted, maximum 6-inch width, 16-gauge-thick, with sealed edges.
  - 3. Blade Action: Parallel.
- E. Blade Seals: Neoprene, mechanically locked.
- F. Blade Axles:
  - 1. Material: Galvanized steel.
  - 2. Diameter: 0.20 inch.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.
- I. Bearings: Steel ball Brass sleeve or synthetic pivot bushings.
- J. Damper Actuator - Electric:
  - 1. Electric - 24 V ac.
  - 2. UL 873 plenum rated.
  - 3. Two position with fail-safe spring return.
    - a. Sufficient motor torque and spring torque to drive damper fully closed with adequate force to achieve required damper seal.
    - b. Minimum 90-degree drive rotation.
  - 4. Clockwise or counterclockwise drive rotation as required for application.

5. Environmental Operating Range:
    - a. Temperature: Minus 40 to plus 130 deg F.
    - b. Humidity: 5 to 95 percent relative humidity noncondensing.
  6. Environmental Enclosure: NEMA 2.
  7. Actuator to be factory mounted and provided with a single-point wiring connection.
- K. Damper Actuator - Pneumatic:
1. Operated by 0 to 20 psig pneumatic signal.
  2. Two position with fail-safe spring return.
    - a. Sufficient power and spring force to drive damper fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
  3. Actuator to be factory mounted.
- L. Controllers, Electrical Devices, and Wiring:
1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
  2. Electrical Connection: 24 V, 60 Hz.
- M. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
  2. Counterweights and spring-assist kits for vertical airflow installations.
  3. Chain pulls.
  4. Screen Mounting:
    - a. Front mounted in sleeve.
      - 1) Sleeve Thickness: 20 gauge minimum.
      - 2) Sleeve Length: 6 inches minimum.
  5. Screen Material: Galvanized steel.
  6. Screen Type: Bird.
  7. 90-degree stops.
- 2.3 BAROMETRIC RELIEF DAMPERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
  2. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  3. Safe Air - Dowco.
- B. General Requirements:
1. Suitable for horizontal or vertical mounting.
  2. Maximum Air Velocity: 1250 fpm.
  3. Maximum System Pressure: 3 inches wg.
- C. Construction:
1. Frame: Hat shaped, 16-gauge-thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
  2. Blades:
    - a. Multiple, 16-gauge-thick, galvanized sheet steel.
    - b. Maximum Width: 6 inches.
    - c. Action: Parallel.
    - d. Balance: Gravity.
    - e. Eccentrically pivoted.
  3. Blade Seals: Neoprene.
  4. Blade Axles: Galvanized steel.
  5. Tie Bars and Brackets:
    - a. Material: Galvanized steel.
    - b. Rattle free with 90-degree stop.
  6. Bearings: Stainless steel.
- D. Pressure Adjustment: Return spring or counter weight with adjustable tension.
- E. Accessories:
1. Flange on intake.
  2. Adjustment device to permit setting for varying differential static pressures.
  - 3.

## 2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aire Technologies, Inc.; DMI Companies.
    - b. Greenheck Fan Corporation.
    - c. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  2. Performance:
    - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
  3. Construction:
    - a. Linkage out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  4. Frames:
    - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized steel; 16 gauge thick.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
  8. Tie Bars and Brackets: Galvanized steel.
  9. Locking device to hold damper blades in a fixed position without vibration.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Arrow United Industries; Mestek, Inc.
    - b. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
    - c. Safe Air - Dowco.
  2. Performance:
    - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
  3. Construction:
    - a. Linkage out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  4. Frames:
    - a. Hat-shaped, 0.10-inch-thick, aluminum sheet channels.
    - b. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
  8. Tie Bars and Brackets: Aluminum.
  9. Locking device to hold damper blades in a fixed position without vibration.
- C. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance; MESTEK, Inc.
    - b. Greenheck Fan Corporation.
    - c. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  2. Performance:
    - a. AMCA Certification: Test and rate in accordance with AMCA 511.

- b. Leakage:
    - 1) Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
    - 2) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
    - 3) Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
  3. Construction:
    - a. Linkage: Out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  4. Frames:
    - a. Hat, U, or angle shaped.
    - b. Thickness: 16-gauge galvanized sheet steel.
    - c. Mitered and welded corners.
    - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized, roll-formed steel; 16 gauge thick.
  6. Blade Edging Seals:
    - a. Closed-cell neoprene.
    - b. Inflatable seal blade edging or replaceable rubber seals.
  7. Blade Jamb Seals: Flexible metal compression type.
  8. Blade Axles: Galvanized steel.
  9. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
  10. Tie Bars and Brackets: Galvanized steel.
  11. Locking device to hold damper blades in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance; MESTEK, Inc.
    - b. Arrow United Industries; Mestek, Inc.
    - c. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  2. Performance:
    - a. AMCA Certification: Test and rate in accordance with AMCA 511.
    - b. Leakage:
      - 1) Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
      - 2) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
      - 3) Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
  3. Construction:
    - a. Linkage out of airstream.
    - b. Suitable for horizontal or vertical airflow applications.
  4. Frames:
    - a. Hat, U, or angle shaped.
    - b. Thickness: 0.08-inch aluminum sheet channels.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Roll-Formed Aluminum Blades: 0.072-inch thick aluminum sheet.
    - d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
  6. Blade Edging Seals:
    - a. Closed-cell neoprene.
    - b. Inflatable seal blade edging or replaceable rubber seals.
  7. Blade Jamb Seals: Flexible metal compression type.
  8. Blade Axles: Galvanized steel.

9. Bearings:
  - a. Oil-impregnated bronze.
  - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.
10. Tie Bars and Brackets: Galvanized steel.
11. Locking device to hold damper blades in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Greenheck Fan Corporation.
3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

B. General Requirements:

1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
  - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
  - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
  - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
  - d. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
  - a. Hat, U, or angle shaped.
  - b. 0.08-inch-thick extruded aluminum.
  - c. Mitered and welded corners.
  - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
  - a. Multiple blade with maximum blade width of 6 inches.
  - b. Parallel-blade design.
  - c. Galvanized steel.
  - d. 16-gauge-thick single skin.
5. Blade Edging Seals:
  - a. Replaceable Closed-cell neoprene.

- b. Inflatable seal blade edging, or replaceable rubber seals.
    6. Blade Jamb Seal: Flexible stainless steel, compression type.
    7. Blade Axles: 1/2-inch diameter; galvanized steel.
    8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
    9. Bearings:
      - a. Oil-impregnated bronze.
      - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.
  - E. Damper Actuator - Electric:
    1. Electric - 24 V ac.
    2. UL 873, plenum rated.
    3. Two position with fail-safe spring return.
      - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
      - b. Minimum 90-degree drive rotation.
    4. Clockwise or counterclockwise drive rotation as required for application.
    5. Environmental Operating Range:
      - a. Temperature: Minus 40 to plus 130 deg F.
      - b. Humidity: 5 to 95 percent relative humidity noncondensing.
    6. Environmental enclosure: NEMA 2.
    7. Actuator to be factory mounted and provided with a single-point wiring connection.
  - F. Damper Actuator - Pneumatic:
    1. Operated by 0 to 20 psig pneumatic signal.
    2. Two position with fail-safe spring return.
      - a. Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.
      - b. Maximum 15-second full-stroke closure.
    3. Actuator to be factory mounted.
  - G. Controllers, Electrical Devices, and Wiring:
    1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
    2. Electrical Connection: 24 V, 60 Hz.
- 2.6 FIRE DAMPERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Air Balance; MESTEK, Inc.
    2. Greenheck Fan Corporation.
    3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  - B. Type: Static and dynamic; rated and labeled in accordance with UL 555 by an NRTL.
  - C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.
  - D. Fire Rating: 1-1/2 and 3 hours.
  - E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
  - F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.
  - G. Mounting Orientation: Vertical or horizontal as indicated.
  - H. Blades: Roll-formed galvanized sheet steel,. Material gauge is to be in accordance with UL listing.
  - I. Horizontal Dampers: Include blade lock and stainless steel closure spring.
  - J. Heat-Responsive Device:
    1. Replaceable, 165 deg F rated, fusible links.
    2. Electric, replaceable link and switch package, factory installed, 165 deg F rated.
- 2.7 SMOKE DAMPERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Aire Technologies, Inc.; DMI Companies.
    2. Greenheck Fan Corporation.
    3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.

- B. General Requirements:
1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
  2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
  3. Unless otherwise indicated, use parallel-blade configuration.
  4. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
  5. Factory install damper actuator by damper manufacturer as integral part of damper assembly. Coordinate actuator location, mounting, and electrical requirements with damper manufacturer.
- C. Performance:
1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
  2. Leakage:
    - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
    - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
    - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
  3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
  4. Velocity: Up to 3000 fpm.
  5. Temperature: Minus 25 to plus 180 deg F.
  6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- D. Construction:
1. Suitable for horizontal or vertical airflow applications.
  2. Linkage out of airstream.
  3. Frame:
    - a. Hat shaped.
    - b. Galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.
    - c. Gauge in accordance with UL listing.
  4. Blades:
    - a. Roll-formed, horizontal, v-groove airfoil, galvanized sheet steel.
    - b. Maximum width and gauge in accordance with UL listing.
  5. Blade Edging Seals:
    - a. Silicone rubber.
  6. Blade Jamb Seal: Flexible stainless steel, compression type.
  7. Blade Axles: 1/2-inch diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.
  8. Bearings:
    - a. Oil-impregnated bronze.
- E. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking; gauge in accordance with UL listing.
- F. Damper Actuator - Electric:
1. Electric - 24 V ac.
  2. UL 873, plenum rated.
  3. Designed to operate in smoke-control systems complying with UL 555S requirements.
  4. Two position with fail-safe spring return.
    - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
    - c. Minimum 90-degree drive rotation.
  5. Clockwise or counterclockwise drive rotation as required for application.
  6. Environmental Operating Range:
    - a. Temperature: Minus 40 to plus 130 deg F.
    - b. Humidity: 5 to 95 percent relative humidity noncondensing.
  7. Environmental Enclosure: NEMA 2.
  8. Actuator to be factory mounted and provided with single-point wiring connection.
- G. Damper Actuator - Pneumatic:
1. Operated by 0 to 20 psig pneumatic signal.
  2. Designed to operate in smoke-control systems complying with UL 555S requirements.

3. Two position with fail-safe spring return.
    - a. Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
  4. Actuator to be factory mounted.
- H. Controllers, Electrical Devices, and Wiring:
1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
  2. Electrical Connection: 24 V, 60 Hz.
- I. Accessories:
1. Auxiliary switches for signaling fan control or position indication.
  2. Test and reset switches, damper mounted.
  3. Smoke Detector: Integral, factory wired for single-point connection.
- 2.8 COMBINATION FIRE AND SMOKE DAMPERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aire Technologies, Inc.; DMI Companies.
  2. Greenheck Fan Corporation.
  3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
- B. General Requirements:
1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
  2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
  3. Unless otherwise indicated, use parallel-blade configuration.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Performance:
1. AMCA Certification: Test and rate in accordance with AMCE Publication 511.
  2. Leakage:
    - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
    - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
    - c. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.
  3. Pressure Drop: 0.05 in. wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
  4. Velocity: Up to 3000 fpm.
  5. Temperature: Minus 25 to plus 180 deg F.
  6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
- F. Construction:
1. Suitable for horizontal or vertical airflow applications.
  2. Linkage out of airstream.
  3. Frame:
    - a. Hat shaped.
    - b. Galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.
    - c. Gauge is to be in accordance with UL listing.
  4. Blades:
    - a. Roll-formed, horizontal, v-groove airfoil, galvanized sheet steel.
    - b. Maximum width and gauge in accordance with UL listing.
  5. Blade Edging Seals:
    - a. Silicone rubber.
  6. Blade Jamb Seal: Flexible stainless steel, compression type.
  7. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.
  8. Bearings:
    - a. Oil-impregnated bronze.



- G. Mounting Sleeve:
  - 1. Factory installed, galvanized sheet steel.
  - 2. Length to suit wall or floor application with factory-furnished silicone caulking.
  - 3. Gauge in accordance with UL listing.
- H. Heat-Responsive Device:
  - 1. Resettable, 165 deg F rated, fusible links fire-closure device.
  - 2. Electric resettable device and switch package, factory installed, rated.
- I. Master control panel for use in dynamic smoke-management systems.
- J. Damper Actuator - Electric:
  - 1. Electric - 24 V ac.
  - 2. UL 873, plenum rated.
  - 3. Designed to operate in smoke-control systems complying with UL 555S requirements.
  - 4. Two position with fail-safe spring return.
    - a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
    - c. Minimum 90-degree drive rotation.
  - 5. Clockwise or counterclockwise drive rotation as required for application.
  - 6. Environmental Operating Range:
    - a. Temperature: Minus 40 to plus 130 deg F.
    - b. Humidity: 5 to 95 percent relative humidity noncondensing.
  - 7. Environmental Enclosure: NEMA 2.
  - 8. Actuator to be factory mounted and provided with single-point wiring connection.
- K. Damper Actuator - Pneumatic:
  - 1. Operated by 0 to 20 psig pneumatic signal.
  - 2. Designed to operate in smoke control systems complying with UL 555S requirements.
  - 3. Two position with fail-safe spring return.
    - a. Sufficient power and spring force to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    - b. Maximum 15-second full-stroke closure.
  - 4. Actuator to be factory mounted.
- L. Controllers, Electrical Devices, and Wiring:
  - 1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
  - 2. Electrical Connection: 24 V, 60 Hz.
- M. Accessories:
  - 1. Auxiliary switches for signaling fan control or position indication.
  - 2. Test and reset switches, damper mounted.
  - 3. Smoke Detector: Integral, factory wired for single-point connection.

## 2.9 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc; a DMI company.
  - 3. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

## 2.10 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Price Industries Limited.
  - 3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
- B. General Requirements:
  - 1. Factory fabricated.

2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
  3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  4. Bearing AMCA's Certified Ratings Seal for prefabricated silencer sound and air performance.
- C. Shape:
1. Rectangular straight with splitters or baffles.
  2. Round straight with center bodies or pods.
  3. Rectangular elbow with splitters or baffles.
  4. Round elbow with center bodies or pods.
  5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A653/A653M, G90, galvanized sheet steel, 0.034 inch thick.
- E. Round Silencer Outer Casing: ASTM A653/A653M, G90, galvanized sheet steel.
1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 22 gauge thick.
  2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 20 gauge thick.
  3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 18 gauge thick.
  4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 16 gauge thick.
- F. Inner Casing and Baffles: ASTM A653/A653M, G90 galvanized sheet metal, 22 gauge thick, and with 1/8-inch-diameter perforations.
- G. Special Construction:
1. Suitable for outdoor use.
  2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
  2. Dissipative type with fill material.
    - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
    - b. Erosion Barrier: Polymer bag enclosing fill, heat-sealed before assembly.
  3. Lining: None.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
1. Joints: Lock formed and sealed Continuously welded or flanged connections.
  2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
  3. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Accessories:
1. Integral 1-1/2-hour fire damper with access door. Access door to be high transmission loss to match silencer.
  2. Factory-installed end caps to prevent contamination during shipping.
  3. Removable splitters.
  4. Airflow-measuring devices.
- L. Source Quality Control:
1. Test in accordance with ASTM E477.
  2. Testing to be witnessed by Owner.
  3. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000 fpm face velocity.
  4. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
- M. Capacities and Characteristics:
1. Configuration: Straight.
  2. Shape: Rectangular.
  3. Attenuation Mechanism: Acoustical glass fiber.
  4. Maximum Pressure Drop: 0.35 inch wg.
  5. Casing:
    - a. Attenuation: Standard.

- b. Outer Material: Galvanized steel.
- c. Inner Material: Galvanized steel.
- 6. Accessories:
  - a. Access door.
  - b. Birdscreen.

#### 2.11 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Aero-Dyne Sound Control Co.
  - 2. CL WARD & Family Inc.
  - 3. Ductmate Industries, Inc; a DMI company.
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- E. Vane Construction:
  - 1. Single wall.
  - 2. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

#### 2.12 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. DynAir; a Carlisle Company.
  - 2. METALAIRE, Inc.
  - 3. United Enertech Corp.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Copper.
- D. Cable: Steel.
- E. Wall-Box Mounting: Surface.
- F. Wall-Box Cover-Plate Material: Steel.

#### 2.13 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. 24-gauge-thick galvanized steel or 0.032-inch thick aluminum or 24-gauge-thick stainless steel door panel.
    - d. Vision panel.
    - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - f. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
    - a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
      - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
    - C. Pressure Relief Access Door:
      - 1. Door and Frame Material: Galvanized sheet steel.
        - a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum or 24-gauge-thick stainless steel door panel.
      - 2. Door: Single wall with metal thickness applicable for duct pressure class.
      - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
      - 4. Factory set at 3.0 to 8.0 inches wg.
      - 5. Doors close when pressures are within set-point range.
      - 6. Hinge: Continuous piano.
      - 7. Latches: Cam.
      - 8. Seal: Neoprene or foam rubber.
      - 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.
- 2.14 DUCT ACCESS PANEL ASSEMBLIES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1. CL WARD & Family Inc.
    - 2. Ductmate Industries, Inc; a DMI company.
    - 3. Flame Gard, Inc.
  - B. Access panels used in cooking applications:
    - 1. Labeled compliant to NFPA 96 for grease duct access doors.
    - 2. Labeled in accordance with UL 1978 by an NRTL.
  - C. Panel and Frame: Minimum thickness 16-gauge carbon steel.
  - D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
  - E. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
  - F. Minimum Pressure Rating: 10 inches wg positive or negative.
- 2.15 FLEXIBLE CONNECTORS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1. CL WARD & Family Inc.
    - 2. Ductmate Industries, Inc; a DMI company.
    - 3. Elgen Manufacturing.
  - B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
  - C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - D. Materials: Flame-retardant or noncombustible fabrics.
  - E. Coatings and Adhesives: Comply with UL 181, Class 1.
  - F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
  - G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
    - 1. Minimum Weight: 26 oz./sq. yd..
    - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
    - 3. Service Temperature: Minus 40 to plus 200 deg F.
  - H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
    - 1. Minimum Weight: 24 oz./sq. yd..
    - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
    - 3. Service Temperature: Minus 50 to plus 250 deg F.

- I. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
    - 1. Minimum Weight: 16 oz./sq. yd..
    - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
    - 3. Service Temperature: Minus 67 to plus 500 deg F.
  - J. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
    - 1. Minimum Weight: 14 oz./sq. yd..
    - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
    - 3. Service Temperature: Minus 67 to plus 500 deg F.
  - K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
    - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
    - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
    - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
    - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
    - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- 2.16 DUCT ACCESSORY HARDWARE
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1. Ductmate Industries, Inc; a DMI company.
    - 2. Elgen Manufacturing.
    - 3. Ward Industries; a brand of Hart & Cooley, LLC.
  - B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
  - C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
- 2.17 MATERIALS
- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
    - 1. Galvanized Coating Designation: G90.
    - 2. Exposed-Surface Finish: Mill phosphatized.
  - B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
  - C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
  - D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
  - E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
  - F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install fire and smoke dampers in accordance with UL listing.
- I. Duct security bars:
  - 1. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints, and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to four sides and both ends of sleeve.
  - 2. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
  - 3. Secure duct security bar assembly to building structure as indicated in manufacturer's installation instructions.
- J. Connect ducts to duct silencers with flexible duct connectors.
- K. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-ft. spacing.
  - 8. Upstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. For grease ducts, install at locations and spacing as required by NFPA 96.
  - 11. Control devices requiring inspection.
  - 12. Elsewhere as indicated.
- L. Install access doors with swing against duct static pressure.
- M. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- N. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- O. Install flexible connectors to connect ducts to equipment.
- P. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- Q. Install duct test holes where required for testing and balancing purposes.
- R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

## SECTION 23 33 46

### FLEXIBLE DUCTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Flexible ducts, noninsulated.
  - 2. Flexible ducts, insulated.
  - 3. Flexible duct connectors.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Flexible ducts, noninsulated.
  - 2. Flexible ducts, insulated.
  - 3. Flexible duct connectors.
- B. Product Data Submittals: For each type of product.
- C. Shop Drawings: For flexible ducts.
  - 1. Include plans showing locations, mounting details, and attachment details.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

#### PART 2 - PRODUCTS

##### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
- D. Comply with ASTM E96/E96M.

##### 2.2 FLEXIBLE DUCTS, NONINSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Noninsulated - Class 1, Two-Ply Vinyl or Polyethylene Film Supported by Helically Wound, Spring-Steel Wire:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexmaster U.S.A., Inc.
    - b. JP Lamborn Co.
    - c. Thermaflex; a Flex-Tek Group company.
  - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  - 3. Maximum Air Velocity: 4000 fpm.
  - 4. Temperature Range: Minus 10 to plus 160 deg F.
- C. Flexible Ducts, Noninsulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Flexmaster U.S.A., Inc.



2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 175 deg F.
- D. Flexible Ducts, Noninsulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 210 deg F.
- E. Flexible Ducts, Noninsulated - Class 1, Aluminum Laminate and Polyester Film with Latex Adhesive Supported by Helically Wound, Spring-Steel Wire:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 210 deg F.
- F. Flexible Ducts, Noninsulated - Class 0, Interlocking Spiral of Aluminum Foil:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ATCO Rubber Products, Inc.
    - b. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 8 inch wg positive or negative.
  3. Maximum Air Velocity: 5000 fpm.
  4. Temperature Range: Minus 100 to plus 435 deg F.
- 2.3 FLEXIBLE DUCTS, INSULATED
- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ATCO Rubber Products, Inc.
    - b. Flexmaster U.S.A., Inc.
    - c. Thermaflex; a Flex-Tek Group company.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 10 to plus 160 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- C. Flexible Ducts, Insulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexmaster U.S.A., Inc.
    - b. JP Lamborn Co.
    - c. Thermaflex; a Flex-Tek Group company.
  2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 175 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- D. Flexible Ducts, Insulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexmaster U.S.A., Inc.
    - b. JP Lamborn Co.
    - c. Thermaflex; a Flex-Tek Group company.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 210 deg F.

5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- E. Flexible Ducts, Insulated - Class 1, Aluminum Laminate and Polyester Film with Latex Adhesive Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 210 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- F. Flexible Ducts, Insulated - Class 0, Interlocking Spiral of Aluminum Foil; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 8 inch wg positive or negative.
  3. Maximum Air Velocity: 5000 fpm.
  4. Temperature Range: Minus 20 to plus 250 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- 2.4 FLEXIBLE DUCT CONNECTORS
- A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action Nylon strap in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Adhesive.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF FLEXIBLE DUCTS**

- A. Install flexible ducts in accordance with applicable details in the following publications:
1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
  2. NAIMA AH116.
  3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
  4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers and light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with liquid adhesive plus tape.
- F. Installation:
1. Install ducts fully extended.
  2. Do not bend ducts across sharp corners.
  3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
  4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  5. Install flexible ducts in a direct line, without sags, twists, or turns.
  6. Install in accordance with ADC instructions.
- G. Supporting Flexible Ducts:
1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft.. Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.
  2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
  3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.

4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 33 46

## SECTION 23 34 00

### HVAC FANS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Ventilators, centrifugal - roof-mounted downblast.
  - 2.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product.
    - a. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
    - b. Rated capacities, furnished specialties, and accessories for each fan.
    - c. Fans:
      - 1) Certified fan performance curves with system operating conditions indicated.
      - 2) Certified fan sound-power ratings.
      - 3) Fan construction and accessories.
      - 4) Motor ratings and electrical characteristics, plus motor and electrical accessories.
      - 5) Fan speed controllers.
    - d. Material thickness and finishes, including color charts.
    - e. Dampers, including housings, linkages, and operators.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
  - 4. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
  - 5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated Design Submittal: For vibration isolation, supports, indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for selecting vibration isolators, supports,.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans showing fan rooms and fan system layouts, reflected ceiling plans, and other drawings required to illustrate relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Seismic Qualification Data: Certificates, for fans, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Startup service reports.
- D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fans and ventilators, include the following:
1. Operation in normal and emergency modes.
  2. Operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.
1. Belts: One set(s) for each belt-driven unit.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation, supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 VENTILATORS, CENTRIFUGAL - ROOF-MOUNTED DOWNBLAST

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
  2. Loren Cook Company.
  3. PennBarry; division of Air System Components.
- B. Source Limitations: Obtain roof-mounted downblast centrifugal ventilators from single manufacturer.
- C. Standards: Comply with UL 705.
- D. Housing: Downblast; removable spun-aluminum dome top and outlet baffle extruded-aluminum rectangular top galvanized-steel mushroom-domed top spun aluminum; square, one-piece aluminum base with venturi inlet cone.
- E. Fan Wheels: Aluminum hub and wheel with backward-inclined blades; spark-resistant construction classified in accordance with AMCA 99, Section 8, Type A.
- F. Belt Drives:
1. Resiliently mounted to housing.
  2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  4. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions. Provide fixed pitch for use with motors larger than 5 hp.
  6. Fan and motor are isolated from exhaust airstream.
- G. Accessories:
1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
  3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

6. Spark-resistant, all-aluminum wheel construction.
  7. Mounting Pedestal: Galvanized steel with removable access panel.
- H. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
1. Configuration: Self-flashing without a cant strip, with mounting flange Manufactured to accommodate roof slope.
  2. Overall Height: 12 inches.
  3. Sound Curb: Curb with sound-absorbing insulation.
  4. Hinged sub-base to provide access to damper or as cleanout for grease applications.
  5. Burglar Bars: 1/2-inch- thick steel bars welded in place to form 6-inch squares.
  6. Pitch Mounting: Manufacture curb for roof slope.
  7. Metal Liner: Galvanized steel.
  8. Mounting Pedestal: Galvanized steel with removable access panel.
- 2.3 MOTORS
- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 00 "Common Work Results for HVAC."
  - B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.
- 2.4 SOURCE QUALITY CONTROL
- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
  - B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
  - C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
  - D. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

### **PART 3 - EXECUTION**

- 3.1 INSTALLATION, GENERAL
- A. Install fans level and plumb.
  - B. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.
  - C. Lift and support units with manufacturer's designated lifting or supporting points.
  - D. Equipment Mounting:
    1. Install floor-mounted fans on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
    2. Install roof-mounted fans on roof curbs or support steel. See Drawings for specific requirements.
    3. Unit Support: Install fans level on structural curbs. Coordinate with duct connections. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.
    4. Support duct-mounted and other hanging fans directly from the building structure, using suitable hanging systems as specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
    5. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
    6. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
  - E. Curb Support, Prefabricated: Rail-type wood support provided by fan manufacturer.
  - F. Unit Support: Install centrifugal fans level on structural curbs. Coordinate with duct connections. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

- G. Isolation Curb Support: Install centrifugal fans on isolation curbs, and install flexible duct connectors and vibration-isolation and seismic-control devices.
    - 1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
    - 2. Comply with requirements in Section 23 05 48.13 "Vibration Controls for HVAC."
  - H. Install units with adequate clearances for service and maintenance.
  - I. Label fans in accordance with requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- 3.2 DUCTWORK CONNECTIONS
- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."
  - B. Where installing ducts adjacent to fans, allow space for service and maintenance.
- 3.3 PIPING CONNECTIONS
- A. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.
  - B. Install heat tracing on all drain piping subject to freezing temperature and as indicated on Drawings. Furnish and install heat tracing in accordance with Section 23 05 33 "Heat Tracing for HVAC Piping."
- 3.4 ELECTRICAL CONNECTIONS
- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
  - B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
  - C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
  - D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
    - 1. Nameplate is to be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
    - 2. Nameplate is to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.
- 3.5 CONTROL CONNECTIONS
- A. Install control and electrical power wiring to field-mounted control devices.
  - B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- 3.6 STARTUP SERVICE:
- A. Perform startup service.
    - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
    - 2. Verify that shipping, blocking, and bracing are removed.
    - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
    - 4. Verify that cleaning and adjusting are complete.
    - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
    - 6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
    - 7. Adjust belt tension.
    - 8. Adjust damper linkages for proper damper operation.
    - 9. Verify lubrication for bearings and other moving parts.
    - 10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.7 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.
- D. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.8 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
  1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  2. Test and adjust controls and safeties.
  3. Fans and components will be considered defective if they do not pass tests and inspections.
  4. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans.

END OF SECTION 23 34 00



## SECTION 23 36 00

### AIR TERMINAL UNITS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Bypass, single-duct air terminal units.
  2. Modulating, single-duct air terminal units.
  3. Parallel fan-powered air terminal units.
  4. Series fan-powered air terminal units.
  5. Dual-duct air terminal units.
  6. Induction air terminal units.
  7. Diffuser-type air terminal units.
  8. Balancing terminal units.
  9. Pressure-control terminal units.
  10. Critical environment control valve.
  11. Underfloor air distribution terminal units.
  12. Exhaust single-duct terminal units.
  13. DOAS, series, fan-powered air terminal units.
  14. Casing liner.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of air terminal unit.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For air terminal units.
1. Include plans, elevations, sections, and mounting details.
  2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.
  4. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated Design Submittal: For vibration isolation and supports, indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Materials, fabrication, assembly, and spacing of hangers and supports.
  2. Design Calculations: Calculate requirements for selecting vibration isolators, supports,.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, indicating the items described in this Section, and coordinated with all building trades.
- B. Seismic Qualification Data: For air terminal units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Instructions for resetting minimum and maximum air volumes.
    - b. Instructions for adjusting software set points.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a Qualified Electrical Testing Laboratory, and marked for intended location and application.
- B. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."
- D. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation, supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

#### 2.2 MODULATING, SINGLE-DUCT AIR TERMINAL UNITS VAV-1 THRU VAV-9

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carnes Company.
  - 2. Price Industries Limited.
  - 3. Titus; brand of Johnson Controls International plc, Global Products.
- B. Description: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: Minimum 20-gauge- thick galvanized steel.
  - 1. Casing Liner: Comply with requirements in "Casing Liner" Article below.
  - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 3. Air Outlet: S-slip and drive connections, size matching inlet size.
  - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: AHRI 880 rated, 1 percent of nominal airflow at 3-inch wg inlet static pressure.
- E. Velocity Sensors: Multipoint array with velocity inlet sensors.
- F. Attenuator Section: Casing material and thickness matching associated air terminal unit casing. Provide packless attenuator integral with the air terminal unit, with noise transmission loss performance as required in schedules on Drawings.
- G. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch. Include manual air vent and drain valve. Provide hydronic heating coils for air terminal units scheduled on Drawings.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless steel, machine-staked terminals secured with stainless steel hardware. Provide electric-resistance heating coils for air terminal units scheduled on Drawings.
  - 1. Stage(s): One.

2. SCR controlled.
  3. Access door interlocked disconnect switch.
  4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
  5. Nickel chrome 80/20 heating elements.
  6. Airflow switch for proof of airflow.
  7. Fan interlock contacts.
  8. Fuses in terminal box for overcurrent protection (for coils of more than 48 A).
  9. Pneumatic-electric switches and relays.
  10. Magnetic contactor for each step of control (for three-phase coils).
- I. Electric Controls:
1. Electric Damper Actuator: 24 V, spring-return open.
  2. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.
  3. Air Volume Controls: Pressure-dependent volume controls with field-adjustable minimum and maximum position stops.
- J. Electronic Controls:
1. Electronic Damper Actuator: 24 V, spring-return open.
  2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
  3. Electronic Air Volume Controller: Pressure-independent analog electronic controller, factory calibrated and field adjustable to minimum and maximum air volumes; provides consistent airflow to the space in response to electronic thermostat signal while compensating for inlet static-pressure variations of up to 4 inches wg; includes a multipoint velocity sensor at air inlet.
- K. Pneumatic Controls:
1. Pneumatic Damper Actuator: 0 to 13 psig spring range.
  2. Pneumatic Thermostat: Wall-mounted pneumatic type direct acting and reverse acting with appropriate mounting hardware.
  3. Pneumatic Air Volume Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; provides consistent airflow to the space in response to pneumatic thermostat signal while compensating for inlet static-pressure variations of up to 4 inches wg; includes a multipoint velocity sensor at air inlet.
- L. Direct Digital Controls:
1. Terminal Unit Controller: Pressure-independent, VAV controller and integrated actuator, and electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes.
    - a. Occupied and unoccupied operating mode.
    - b. Remote reset of airflow or temperature set points.
    - c. Adjusting and monitoring with portable terminal.
    - d. Communication with temperature-control system specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
  2. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.
  3. Terminal Unit Controller, Section 23 09 23: Controller is to be factory mounted and wired by air terminal manufacturer; unit controllers, integrated actuators, and room sensors to be furnished under Section 23 09 23 "Direct Digital Controls (DDC) for HVAC."
- M. Control Sequence: See Section 23 09 93 "Sequence of Operation" for control sequences.
- 2.3 CASING LINER
- A. Casing Liner, Fibrous Glass: Fibrous-glass duct liner, complying with ASTM C1071, NFPA 90A or NFPA 90B, and with NAIMA AH124.
1. Minimum Thickness: 1/2 inch.
    - a. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  2. Antimicrobial Erosion-Resistant Coating: Apply to surface of liner that will form interior surface of duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Foil-Faced Liner: Minimum 0.001-inch reinforced, nonporous aluminum foil applied to matted insulation airstream face. Encapsulate all insulation edges with sheet metal angles and channels, or tape.
  4. Solid Metal Liner: Solid galvanized sheet metal encapsulating matted insulation face from airstream.
  5. Perforated Metal Liner: Perforated galvanized sheet metal encapsulating matted insulation face from airstream.
  6. Specialty Liner: Insert specialty liner in coordination with manufacturers.
  7. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
- B. Casing Liner, Flexible Elastomeric: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Minimum Thickness: 1/2 inch.
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- 2.4 SOURCE QUALITY CONTROL
- A. AHRI 880 Certification: Test, rate, and label assembled air terminal units in accordance with AHRI 880.
  - B. AHRI 880: Test and rate assembled air terminal units in accordance with AHRI 880.
  - C. Water Coils: Factory pressure test to 300 psig in accordance with AHRI 410 and ASHRAE 33.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Comply with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" and Section 23 31 13 "Metal Ducts" for hangers and supports.
- B. Install air terminal units according to NFPA 90A.
- C. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- D. Install wall-mounted thermostats.

#### **3.2 DUCTWORK CONNECTIONS**

- A. Comply with requirements in Section 23 31 13 "Metal Ducts" for connecting ducts to air terminal units.
- B. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

#### **3.3 ELECTRICAL CONNECTIONS**

- A. Install field power to each air terminal unit electrical power connection. Coordinate with air terminal unit manufacturer and installers.
- B. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

#### **3.4 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.

- B. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Label each air terminal unit with drawing designation, nominal airflow, maximum and minimum factory-set airflows, and coil type. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.
  - 4. Verify that control connections are complete.
  - 5. Verify that nameplate and identification tag are visible.
  - 6. Verify that controls respond to inputs as specified.
  - 7.

3.7 ADJUSTING

- A. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air terminal unit testing, adjusting, and balancing.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00

## SECTION 23 37 13.13

### AIR DIFFUSERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Ceiling diffusers - round face.
  2. Ceiling diffusers - rectangular and square face.
  3. Diffusers - perforated face.
  4. Diffusers - louver face.
  5. Diffusers - linear bar.
  6. Diffusers - ceiling-integral plenum slot.
  7. Diffusers - ceiling-linear continuous slot.
  8. Diffusers - light troffer.
  9. Diffusers - induction underfloor air distribution, round.
  10. Diffuser plenums - linear underfloor air distribution.
  11. Diffusers - drum louvers, high capacity.
  12. Diffusers - modular-core grille, high capacity.
  13. Diffusers - HEPA, laminar flow, filtered.
  14. Diffusers - jet nozzle and punkah.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
1. For each type of product.
    - a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
    - b. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
  - B. Samples: For each exposed product and for each color and texture specified. Actual size of smallest diffuser indicated.
  - C. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.
  - D. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected. Actual size of smallest diffuser indicated.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension assembly members.
  2. Method of attaching hangers to building structure.
  3. Size and location of initial access modules for acoustical tile.
  4. Ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  5. Duct access panels.
- B. Source quality-control reports.

#### PART 2 - PRODUCTS

##### 2.1 CEILING DIFFUSERS - RECTANGULAR AND SQUARE FACE

- A. Ceiling Diffuser - Rectangular and Square:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. METALAIRE, Inc.
    - b. Price Industries Limited.

- c. Titus; brand of Johnson Controls International plc, Global Products.
2. Description: Square ceiling diffuser with round or rectangular duct collar and a series of curved louvers to provide discharge parallel to ceiling surface.
3. Source Limitations: Obtain from single source from single manufacturer.
4. Material: Aluminum.
5. Finish: Baked enamel, color selected by Architect.
6. Face Size: 24 by 24 inches.
7. Face Style: Three cone.
8. Mounting: T-bar Snap in Mounting panel.
9. Pattern: Fixed.
10. Dampers: Radial opposed blade.
11. Accessories:
  - a. Equalizing grid.
  - b. Plaster ring.
  - c. Safety chain.
  - d. Wire guard.
  - e. Sectorizing baffles.
  - f. Manual remote balancing damper operator.
  - g. UL 555C fire-rated assembly, including fire damper and insulating blanket.

## 2.2 DIFFUSERS - PERFORATED FACE

- A. Diffuser - Perforated Face:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. METALAIRE, Inc.
    - b. Price Industries Limited.
    - c. Titus; brand of Johnson Controls International plc, Global Products.
  2. Description: Square ceiling diffuser with duct collar and perforated face plate.
  3. Source Limitations: Obtain from single source from single manufacturer.
  4. Material: Steel backpan and pattern controllers, with aluminum face.
  5. Finish: Baked enamel, color selected by Architect.
  6. Face Size: 24 by 24 inches.
  7. Duct Inlet: Square.
  8. Face Style: Flush.
  9. Mounting: Surface T-bar Snap in Mounting panel.
  10. Pattern Controller: Four louvered deflector patches.
  11. Dampers: Opposed blade.
  12. Accessories:
    - a. Equalizing grid.
    - b. Plaster ring.
    - c. Safety chain.
    - d. Wire guard.
    - e. Sectorizing baffles.
    - f. Manual remote balancing damper operator.
    - g. UL 555C fire-rated assembly, including fire damper and insulating blanket.

## 2.3 DIFFUSERS - LOUVER FACE

- A. Diffuser - Louver Face:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. METALAIRE, Inc.
    - b. Price Industries Limited.
    - c. Titus; brand of Johnson Controls International plc, Global Products.
  2. Description: Square diffuser with outer border, duct collar, and curved face louvers to direct air discharge in one, two, three, or four directions, parallel to ceiling surface.
  3. Source Limitations: Obtain from single source from single manufacturer.
  4. Material: Aluminum.
  5. Finish: Baked enamel, color selected by Architect.
  6. Face Size: See schedule.
  7. Mounting: Surface Surface with beveled frame.
  8. Pattern: core style as indicated on the Drawings.
  9. Dampers: Radial opposed blade.

10. Accessories:
  - a. Square to round neck adaptor.
  - b. Adjustable pattern vanes.
  - c. Throw reducing vanes.
  - d. Equalizing grid.
  - e. Plaster ring.
  - f. Safety chain.
  - g. Wire guard.
  - h. Sectorizing baffles.
  - i. Manual remote balancing damper operator.
  - j. UL 555C fire-rated assembly including fire damper and insulating blanket.

#### 2.4 DIFFUSERS - CEILING-INTEGRAL PLENUM SLOT

##### A. Diffuser - Ceiling-Integral Plenum Slot:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. METALAIRE, Inc.
  - b. Price Industries Limited.
  - c. Titus; brand of Johnson Controls International plc, Global Products.
2. Description: Diffuser assembly with integral pattern controller, one or more linear discharge slots, and an integral plenum and duct collar. Assembly is to be installed in modular T-bar ceilings.
3. Source Limitations: Obtain from single source from single manufacturer.
4. Material:
  - a. Face: Aluminum.
  - b. Pattern Controller and Tees: Aluminum.
  - c. Plenum: Steel, internally insulated.
  - d. Plenum Insulation: Comply with UL 181.
5. Finish:
  - a. Face and Plenum: Baked enamel.
  - b. Pattern Controller: Baked enamel, black.
  - c. Tees: Baked enamel, color selected by Architect.
6. Slot Width: 1 inch.
7. Number of Slots: See schedule .
8. Length: See schedule.
9. Accessories: See schedule.
10. Fire-Rated Construction: Integral fire damper and fire-rated assembly listing in the Underwriters Laboratory Fire Resistance Directory, tested in accordance with UL 263 and complying with NFPA 90A requirements.

#### 2.5 DIFFUSERS - CEILING-LINEAR CONTINUOUS SLOT

##### A. Diffuser - Ceiling-Linear Continuous Slot:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. METALAIRE, Inc.
  - b. Price Industries Limited.
  - c. Titus; brand of Johnson Controls International plc, Global Products.
2. Description: Linear diffuser assembly with continuous slots; adjustable vane in each slot to direct airflow in required direction.
3. Source Limitations: Obtain from single source from single manufacturer.
4. Slot Width: 1 inch.
5. Section Length: See schedule.
6. Straight and curved sections as required to accommodate layout.
7. Mitered tees and corners.
8. Pattern control vanes.
9. Material: Aluminum, extruded, heavy wall.
10. Finishes:
  - a. Exterior: Standard white.
  - b. Interior: Standard black.
11. Throw: Horizontal.
12. Mounting: Ceiling.
13. Plenum: Insulated.
14. Other Features:
  - a. Blank-offs.



2.6 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers in accordance with ASHRAE 70.

**PART 3 - EXECUTION**

3.1 INSTALLATION OF AIR DIFFUSERS

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.13

## SECTION 23 37 13.23

### REGISTERS AND GRILLES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Registers - adjustable-blade face.
  - 2. Registers - fixed-blade face.
  - 3. Grilles - adjustable-blade face.
  - 4. Grilles - fixed-blade face.
  - 5. Grilles - linear bar.
- B. Related Requirements:
  - 1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
  - 2. Section 23 37 13.13 "Air Diffusers" for various types of air diffusers.
  - 3. Section 23 37 13.43 "Security Registers and Grilles" for security registers and security grilles.
  - 4. Section 23 37 16 "Fabric Air-Diffusion Devices" for continuous tubular diffusers.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of product.
    - a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
    - b. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.
- C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Actual size of smallest register and grille indicated.
- D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Actual size of smallest size register and grille indicated.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.

#### PART 2 - PRODUCTS

##### 2.1 REGISTERS

- A. Registers - Adjustable-Blade Face:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. METALAIRE, Inc.
    - b. Price Industries Limited.
    - c. Titus; brand of Johnson Controls International plc, Global Products.
  - 2. Material: Aluminum.

3. Finish: Baked enamel, color selected by Architect.
4. Face-Blade Arrangement: Face blades with adjustable angle to permit manual adjustment of air discharge direction. Blades horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Rear blades with adjustable angle to permit manual adjustment of air discharge direction. Blades horizontally spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw Lay in.
9. Accessories:
  - a. Damper Type: Adjustable opposed blade.
  - b. Front-blade gang operator.
  - c. Filter.

B. Registers - Fixed-Blade Face:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. METALAIRE, Inc.
  - b. Price Industries Limited.
  - c. Titus; brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face-Blade Arrangement: Fixed-position face blades, horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw Lay in.
8. Damper Type: Adjustable opposed blade.

2.2 GRILLES

A. Grilles - Adjustable-Blade Face:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. METALAIRE, Inc.
  - b. Price Industries Limited.
  - c. Titus; brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face-Blade Arrangement: Face blades with adjustable angle to permit manual adjustment of discharge direction. Blades horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: All rear blades with adjustable angle to permit manual adjustment of air-discharge direction. Blades horizontally spaced 3/4 inch apart.
7. Frame: 1 inch wide.
8. Mounting: Countersunk screw Lay in.
9. Accessories:
  - a. Damper: Opposed blade, spring closing, and with NRTL listed fusible link for 160 deg F.
  - b. Front-blade gang operator.
  - c. Filter.

B. Grilles - Fixed-Blade Face:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. METALAIRE, Inc.
  - b. Price Industries Limited.
  - c. Titus; brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face-Blade Arrangement: Fixed-face blade position, horizontally spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw Lay in.
8. Accessory: Filter.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles in accordance with ASHRAE 70.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION OF REGISTERS AND GRILLES**

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

**3.3 ADJUSTING**

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.23

## SECTION 23 73 43.16

### OUTDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Outdoor, semi-custom air-handling units.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  3. Include unit dimensions and weight.
  4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
  5. Fans:
    - a. Include certified fan-performance curves with system operating conditions indicated.
    - b. Include certified fan-sound power ratings.
    - c. Include fan construction and accessories.
    - d. Include motor ratings, electrical characteristics, and motor accessories.
  6. Include certified coil-performance ratings with system operating conditions indicated.
  7. Include dampers, including housings, linkages, and operators.
- B. Shop Drawings: For each outdoor, semi-custom air-handling unit.
1. Include plans, elevations, sections, and mounting details.
  2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Detail fabrication and assembly of outdoor, semi-custom air-handling units, as well as procedure and diagrams.
  4. Include diagrams for power, signal, and control wiring.
- C. Delegated Design Submittal: For vibration isolation, supports, indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate requirements for selecting vibration isolators, supports, and for designing vibration isolation bases.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Sample Warranty: For manufacturer's warranty.
- C. Seismic Qualification Data: Certificates for air-handling units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  4. Restraint of internal components.
- D. Wind Qualification Data: Certificates for air-handling units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Source quality-control reports.
- F. Startup service reports.
- G. Field quality-control reports.
- 1.4 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.
- 1.5 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Filters: One set(s) for each air-handling unit.
  2. Gaskets: One set(s) for each access door.
  3. Fan Belts: One set(s) for each air-handling unit fan.
- 1.6 WARRANTY
- A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Entire Unit: Manufacturer's standard but not less than one year(s) from date of Substantial Completion.
  2. Warranty Period for Heat Wheels: Not less than five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

- 2.1 PERFORMANCE REQUIREMENTS
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design vibration isolation, supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- F. Structural Performance:
1. Casing Panels: Self-supporting and capable of withstanding positive/negative 8-inch wg internal static pressure, without exceeding a midpoint deflection of 0.0042 inch/inch of panel span.
  2. Floor and Roof Panels: Self-supporting and capable of withstanding 300-lb static load at midspan, without exceeding a midpoint deflection of 0.0042 inch/inch.
  3. Roof Panels: Self-supporting and capable of withstanding a static snow load of 30 lb/sq. ft., without exceeding a midpoint deflection of 0.0042 inch/inch.
- G. Casing Leakage Performance: ASHRAE 111, Class 6 leakage or better at plus or minus 8-inch wg.
- 2.2 CAPACITIES AND CHARACTERISTICS
- A. Supply Fan:
1. Type: SWSI, airfoil unshoused centrifugal fan.
  2. Class: AMCA 99, Section 14, Class II.
  3. Drive: Direct.
  4. Number of Fan Wheels: See schedule.

5. Fan Diameter: See schedule.
  6. Airflow: See schedule.
  7. Total Static Pressure: See schedule.
  8. External Static Pressure: See schedule.
  9. Speed: See schedule.
  10. Maximum Outlet Velocity: See schedule.
  11. Motor:
    - a. Size: See schedule.
    - b. Speed: See schedule.
    - c. Volts: 460 V.
    - d. Phase: Three.
    - e. Hertz: 60 Hz.
    - f. Full-Load Amperes: See schedule.
    - g. Minimum Circuit Ampacity: See schedule.
    - h. Maximum Overcurrent Protection: See schedule.
- B. Fan: Exhaust.
1. Type: SWSI, airfoil unhooded centrifugal plenum fan.
  2. Class: AMCA 99, Section 14, Class II.
  3. Drive: Direct.
  4. Number of Fan Wheels: See schedule.
  5. Fan Diameter: See schedule.
  6. Airflow: See schedule.
  7. Total Static Pressure: See schedule.
  8. External Static Pressure: See schedule.
  9. Speed: See schedule.
  10. Maximum See schedule.
  11. Motor:
    - a. Size: See schedule.
    - b. Speed: See schedule.
    - c. Volts: 460 V.
    - d. Phase: Three.
    - e. Hertz: 60 Hz.
    - f. Full-Load Amperes: See schedule.
    - g. Minimum Circuit Ampacity: See schedule.
    - h. Maximum Overcurrent Protection: See schedule.
- C. Preheat Coil:
1. Heat-Transfer Rate: See schedule.
  2. Entering-Air Temperature: See schedule.
  3. Leaving-Air Temperature: See schedule.
- D. Heating Coil:
1. Heat-Transfer Rate: See schedule.
  2. Entering-Air Temperature: See schedule.
  3. Leaving-Air Temperature: See schedule.
- E. Cooling Coil:
1. Sensible Heat-Transfer Rate: See schedule.
  2. Total Heat-Transfer Rate: See schedule.
  3. Entering-Air, Dry-Bulb Temperature: See schedule.
  4. Entering-Air, Wet-Bulb Temperature: See schedule.
  5. Leaving-Air, Dry-Bulb Temperature: See schedule.
  6. Leaving-Air, Wet-Bulb Temperature: See schedule.
  7. Refrigerant:
    - a. Refrigerant Type: R-32.
- F. Prefilters:
1. Minimum Efficiency Reporting Value:
    - a. MERV Rating: MERV 13, according to ASHRAE 52.2.
- G. Final Filters:
1. Minimum Efficiency Reporting Value:
    - a. MERV Rating: MERV 13, according to ASHRAE 52.2.

- H. SCCR:
  - 1. 10kAIC

### 2.3 OUTDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Daikin Applied.
  - 2. YORK; brand of Johnson Controls International plc, Building Solutions North America.
  - 3. AAON.
- B. Source Limitations: Obtain from single source from single manufacturer.
- C. Unit Casings:
  - 1. Frame: Modular and providing overall structural integrity without reliance on casing panels for structural support.
  - 2. Base Rail:
    - a. Material: Galvanized steel.
  - 3. Casing Joints: Hermetically sealed at each corner and around entire perimeter.
  - 4. Double-Wall Construction:
    - a. Outside Casing Wall:
      - 1) Material, Galvanized Steel: Minimum 18 gauge thick.
      - 2) Factory Finish: Provide manufacturer's standard finish.
    - b. Inside Casing Wall:
      - 1) Material, Galvanized Steel: Solid, minimum 18 gauge thick.
  - 5. Floor Plate:
    - a. Material:
      - 1) Galvanized steel, treadplate, minimum 18 gauge thick.
    - b. Antimicrobial Coating: Applied during the manufacturing process. EPA approved.
  - 6. Roof: Cross-broken and pitched with "C" caps over joints to provide watertight seal.
  - 7. Piping Vestibule: Insulated with same insulation and thickness as casing, 18 inches deep by full width of piping connections.
  - 8. Casing Insulation:
    - a. Materials: Glass-fiber blanket or board insulation, Type I or Type II ASTM C1071 or injected polyurethane foam insulation.
    - b. Casing Panel R-Value: Minimum R-11.
    - c. Insulation Thickness: 2 inches.
    - d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
  - 9. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
  - 10. Panels, Doors, and Windows:
    - a. Panels:
      - 1) Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
      - 2) Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
      - 3) Gasket: Neoprene, applied around entire perimeters of panel frames.
      - 4) Size: Large enough to allow unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches.
    - b. Doors:
      - 1) Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.
      - 2) Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
      - 3) Gasket: Neoprene, applied around entire perimeters of panel frames.
      - 4) Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components. At least 18 inches wide by full height of unit casing up to a maximum height of 60 inches.
    - c. Locations and Applications:
      - 1) Fan Section: Doors.



- 2) Coil Section: Panels.
  - 3) Access Section: Doors.
  - 4) Access Sections Immediately Upstream and Downstream of Coil Sections: Doors.
  - 5) Damper Section: Doors.
  - 6) Filter Section: Doors large enough to allow periodic removal and installation of filters.
  - 7) Access Sections Immediately Upstream and Downstream of Filter Sections: Doors.
  - 8) Mixing Section: Doors.
  - 9) Humidifier Section: Doors.
  - d. Service Lights: LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.
    - 1) Locations: Each section accessed with a door or panel.
  - e. Convenience Outlets: One 20-A duplex GFCI receptacle per location with junction box located on outside casing wall.
    - 1) Locations: Each section accessed with a door or panel.
11. Condensate Drain Pans:
- a. Location: Each type of cooling coil.
  - b. Construction:
    - 1) Single-wall, galvanized-steel or noncorrosive polymer stainless steel sheet.
    - 2) Double-wall, galvanized-steel or noncorrosive polymer stainless steel sheet with space between walls filled with foam insulation and moisture-tight seal.
  - c. Drain Connection:
    - 1) Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 2) Minimum Connection Size: NPS 1.
  - d. Slope: Minimum 0.125-in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
  - e. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
  - f. Width: Entire width of water producing device.
  - g. Depth: A minimum of 2 inches deep.
  - h. Formed sections.
  - i. Pan-Top Surface Coating for Galvanized-Steel Drain Pans: Asphaltic waterproofing compound.
  - j. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- D. Fan, Drive, and Motor Section:
1. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
  2. Fans: Centrifugal, galvanized steel; mounted on solid-steel shaft.
    - a. Shafts: With field-adjustable alignment.
      - 1) Turned, ground, and polished hot-rolled steel with keyway.
    - b. Shaft Bearings:
      - 1) Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with an L-50 rated life of 200,000 hours according to ABMA 9.
      - 2) Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and two-piece, cast-iron housing with grease lines extended to outside unit and an L-50 Insert bearing life rating rated life of 200,000 hours according to ABMA 11.
      - 3) Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit and an L-50 rated life of 200,000.
    - c. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
      - 1) Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
    - d. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
    - e. Plenum Fan Arrays: Contained as defined in AHRI 430. Steel or aluminum frame with inlet cone and structural framing around each fan built into an array of multiple fans. Provide motorized dampers at each fan to prevent short circuiting of flow if one fan is not operating.

- f. Backward-Inclined, Centrifugal Fan Wheels: Construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
- g. Forward-Curved, Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel hub swaged to backplate and fastened to shaft with setscrews.
- h. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
- i. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard restrained vibration isolation mounting devices having a minimum static deflection of 1 inch.
- j. Shaft Lubrication Lines: Extended to a location outside the casing.
- k. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum by.
  - 1) Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
    - a) Fabric Minimum Weight: 26 oz./sq. yd.
    - b) Fabric Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
    - c) Fabric Minimum Service Temperature Range: Minus 40 to plus 200 deg F.
- 3. Drive, Direct: Factory-mounted, direct drive.
- 4. Drive, Belt: Factory-mounted, V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
  - a. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
  - b. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
  - c. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch- thick, 3/4-inch diamond-mesh wire screen, welded to steel angle frame; prime coated.
- 5. Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 00 "Common Work Results for HVAC."
  - b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - c. Enclosure Type: Open, dripproof.
  - d. Enclosure Materials: Cast iron.
  - e. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
  - f. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  - g. Mount unit-mounted disconnect switches on exterior of unit.
- 6. Comply with Section 26 29 23 "Variable-Frequency Motor Controllers."
- 7. Variable-Frequency Motor Controller: Serving each fan individually in fan array.
  - a. Manufactured Units: Pulse-width modulated; constant torque and variable torque for inverter-duty motors.
  - b. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
  - c. Unit Operating Requirements:
    - 1) Internal Adjustability:
      - a) Minimum Speed: 5 to 25 percent of maximum rpm.
      - b) Maximum Speed: 80 to 100 percent of maximum rpm.
      - c) Acceleration: 0.1 to 999.9 seconds.
      - d) Deceleration: 0.1 to 999.9 seconds.
      - e) Current Limit: 30 to minimum of 150 percent of maximum rating.
    - 2) Self-Protection and Reliability Features:
      - a) Surge suppression.
      - b) Loss of input signal protection.
      - c) Under- and overvoltage trips.
      - d) Variable-frequency motor controller and motor-overload/overtemperature protection.

- e) Critical frequency rejection.
  - f) Loss-of-phase protection.
  - g) Reverse-phase protection.
  - h) Motor-temperature fault.
  - 3) Bidirectional autospeed search.
  - 4) Torque boost.
  - 5) Motor temperature compensation at slow speeds.
    - a) Panel-mounted operator station.
    - b) Historical logging information and displays.
    - c) Digital indicating devices.
  - 6) Control Signal Interface: Electric.
  - 7) Proportional Integral Directive (PID) control interface.
  - 8) DDC system for HVAC Protocols for Network Communications: ASHRAE 135.
  - d. Line Conditioning:
    - 1) Input line conditioning.
    - 2) Output filtering.
    - 3) EMI/RFI filtering.
  - e. Bypass Systems:
    - 1) Bypass Mode: Manual operation only.
    - 2) Bypass Controller, Two-Contactor Style: With bypass and output isolating contactors and isolating switch.
    - 3) Bypass Controller, Three-Contactor Style: With bypass and input and output isolating contactors and isolating switch.
    - 4) Bypass Contactor Configuration: Full-voltage (across the line) type.
- E. Coil Section:
- 1. General Requirements for Coil Section:
    - a. Comply with AHRI 410.
    - b. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
    - c. For multizone units, provide air deflectors and air baffles to balance airflow across coils.
    - d. Coils shall not act as structural component of unit.
  - 2. Cooling Coils:
    - a. Refrigerant Coil:
      - 1) Tubes: Copper.
      - 2) Fins:
        - a) Material: Copper.
        - b) Fin Spacing: Maximum 12 fins per inch.
      - 3) Fin and Tube Joints: Mechanical bond.
      - 4) Headers: Seamless-copper headers with brazed connections.
      - 5) Frames: Galvanized steel.
      - 6) Coatings: Corrosion-resistant coating.
      - 7) Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
        - a) Working Pressure: Minimum 300 psig.
- F. Dampers:
- 1. Comply with requirements in Section 23 09 23.12 "Control Dampers."
  - 2. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with zinc-replated steel operating rods rotating in stainless steel sleeve bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1-inch wg and 8 cfm/sq. ft. at 4-inch wg, leakage Class 1, tested, rated, and labeled in accordance with AMCA 511.
  - 3. Face-and-Bypass Dampers: Opposed-blade, galvanized-steel dampers with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.
  - 4. Zone Dampers: Two single-blade, galvanized-steel dampers offset 90 degrees from each other on zinc-plated steel operating rod rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.
  - 5. Damper Operators: Comply with requirements in Section 23 09 23.12 "Control Dampers."

6. Electronic Damper Operators:
    - a. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
    - b. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
    - c. Operator Motors:
      - 1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 00 "Common Work Results for HVAC."
      - 2) Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
      - 3) Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
    - d. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
    - e. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf.
    - f. Size dampers for running torque calculated as follows:
      - 1) Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
      - 2) Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
      - 3) Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
      - 4) Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
      - 5) Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
      - 6) Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
    - g. Coupling: V-bolt and V-shaped, toothed cradle.
    - h. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
    - i. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
    - j. Power Requirements (Two-Position Spring Return): 24 V dc.
    - k. Power Requirements (Modulating): Maximum 10 VA at 24 V ac or 8 W at 24 V dc.
    - l. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
    - m. Temperature Rating: Minus 22 to plus 122 deg F.
    - n. Run Time: 12 seconds open, 5 seconds closed.
  7. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.
  8. Combination Filter and Mixing Section:
    - a. Cabinet support members shall hold 2-inch thick, pleated, flat, permanent or throwaway filters.
    - b. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.
- G. Roof Curbs:
1. Materials: Galvanized steel with corrosion-resistant coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
    - a. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
      - 1) Materials: ASTM C1071, Type I or II.
      - 2) Thickness: 1-1/2 inches.
    - b. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
      - 1) Liner Adhesive: Comply with ASTM C916, Type I.
      - 2) Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
      - 3) Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
  2. Curb Dimensions: Height of 14 inches.
- H. Intake and Relief Air Openings:
1. Provide hood, including moisture eliminator, over all unit intake and relief openings. Match material and finish of casing exterior.

## 2.4 MATERIALS

- A. Steel:
  - 1. ASTM A36/A36M for carbon structural steel.
  - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
  - 1. Manufacturer's standard grade for casing.
  - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Comply with Section 23 05 46 "Coatings for HVAC" for corrosion-resistant coating.
- F. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.
  - 1. Standards:
    - a. ASTM B117 for salt spray.
    - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
    - c. ASTM B3359 for cross-hatch adhesion of 5B.
  - 2. Application: Immersion.
  - 3. Thickness: 1 mil.
  - 4. Gloss: Minimum gloss of 60 on a 60-degree meter.

## 2.5 SOURCE QUALITY CONTROL

- A. AHRI 430 Certification: Test, rate, and label air-handling units and their components in accordance with AHRI 430.
- B. AHRI 1060 Certification: Test, rate, and label air-handling units that include air-to-air energy recovery devices in accordance with AHRI 1060.
- C. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label in accordance with AHRI 260 or AMCA 311.
- D. Fan Aerodynamic Performance Rating: Test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency in accordance with AMCA 210.
- E. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.
- F. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.
- G. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.
- H. Steam Coils: Factory tested to 300 and 200 psig underwater according to AHRI 410 and ASHRAE 33.
- I. Refrigerant Coils: Factory tested to minimum 450-psig internal pressure and to minimum 300-psig internal pressure while underwater, according to AHRI 410 and ASHRAE 33.
- J. Witnessed Casing Leakage Tests:
  - 1. Pay for all expenses, for one representative designated by Owner, to travel to the factory to witness cabinet air-leakage testing on the specific assembled unit(s) prior to release for delivery to Project site.
  - 2. If the unit(s) does not meet specified leakage requirements, perform factory modifications and retest. Do not release unit for shipment until tested leakage is measured to be within specified leakage and leakage testing report has been accepted by Owner's designated representative.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF OUTDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." AHRI Guideline B. Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 07 72 00 "Roof Accessories." Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.
- B. Unit Support: Install unit level on structural curbs. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of curbs with actual equipment provided.
- C. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- E. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

### 3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to air-handling unit, allow space for service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4, ASTM B88, Type M copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Steam and Condensate Piping: Comply with applicable requirements in Section 23 22 13 "Steam and Condensate Heating Piping" and Section 23 22 16 "Steam and Condensate Heating Piping Specialties." Install shutoff valve at steam supply connections, float and thermostatic trap, and union or flange at each coil return connection. Install gate valve and inlet strainer at supply connection of dry steam humidifiers, and inverted bucket steam trap to condensate return connection.
- G. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
  - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 26 05 23 "Control-Voltage Electrical Power Cables."

### 3.6 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  - 6. Verify that zone dampers fully open and close for each zone.
  - 7. Verify that face-and-bypass dampers provide full face flow.
  - 8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
  - 9. Comb coil fins for parallel orientation.
  - 10. Verify that proper thermal-overload protection is installed for electric coils.
  - 11. Install new, clean filters.
  - 12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
  - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
  - 2. Measure and record motor electrical values for voltage and amperage.
  - 3. Manually operate dampers from fully closed to fully open position and record fan performance.

### 3.7 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.8 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. HEPA Filters: Pressurize housing to a minimum of 3-inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.
  - 5. HEPA Filters, Critical Applications: Pressurize housing to a minimum of 3-inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter for air leaks according to ASME AG-1, pressure-decay method.
  - 6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

7. Air-handling unit and components will be considered defective if unit or components do not pass tests and inspections.
8. Prepare test and inspection reports.

3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 43.16



## SECTION 23 81 26

### SPLIT-SYSTEM AIR-CONDITIONERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Split-system air-conditioners.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set(s) for each air-handling unit.
  - 2. Gaskets: One set(s) for each access door.
  - 3. Fan Belts: One set(s) for each air-handling unit fan.

##### 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

##### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Five year(s) from date of Substantial Completion.
    - c. For Labor: Five year(s) from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 SPLIT-SYSTEM AIR-CONDITIONERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mitsubishi Electric & Electronics USA, Inc.
  2. Trane.
  3. Daikin.
- B. Indoor Units (5 tons (18 kW) or Less):
1. Concealed Evaporator-Fan Components:
    - a. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
    - b. Insulation: Faced, glass-fiber duct liner.
    - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
    - d. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
    - e. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
    - f. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
    - g. Fan Motors:
      - 1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 00 "Common Work Results for HVAC."
      - 2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
      - 3) Wiring Terminations: Connect motor to chassis wiring with plug connection.
    - h. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
    - i. Filters: Permanent, cleanable.
    - j. Condensate Drain Pans:
      - 1) Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
        - a) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        - b) Depth: A minimum of 2 inches deep.
      - 2) Single-wall, galvanized-steel sheet.
      - 3) Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
      - 4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
        - a) Minimum Connection Size: NPS 1.
      - 5) Pan-Top Surface Coating: Asphaltic waterproofing compound.
      - 6) Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
  2. Floor-Mounted, Evaporator-Fan Components:
    - a. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.
      - 1) Discharge Grille: Steel with surface-mounted frame.

- 2) Insulation: Faced, glass-fiber duct liner.
- 3) Drain Pans: Galvanized steel, with connection for drain; insulated.
- b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
- c. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
- d. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
- e. Fan: Direct drive, centrifugal, with power-induced outside air.
- f. Fan Motors:
  - 1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 00 "Common Work Results for HVAC."
  - 2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
- g. Air Filtration Section:
  - 1) General Requirements for Air Filtration Section:
    - a) Comply with NFPA 90A.
    - b) Minimum MERV according to ASHRAE 52.2.
    - c) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
  - 2) Disposable Panel Filters:
    - a) Factory-fabricated, viscous-coated, flat-panel type.
    - b) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
  - 3) Extended-Surface, Disposable Panel Filters:
    - a) Factory-fabricated, dry, extended-surface type.
    - b) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
3. Wall-Mounted, Evaporator-Fan Components:
  - a. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - b. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  - c. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
  - d. Fan: Direct drive, centrifugal.
  - e. Fan Motors:
    - 1) Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 00 "Common Work Results for HVAC."
    - 2) Multitapped, multispeed with internal thermal protection and permanent lubrication.
    - 3) Enclosure Type: Totally enclosed, fan cooled.
    - 4) NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    - 5) Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    - 6) Mount unit-mounted disconnect switches on exterior of unit.
  - f. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - g. Condensate Drain Pans:
    - 1) Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      - a) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      - b) Depth: A minimum of 1 inch deep.
    - 2) Single-wall, galvanized-steel sheet.

- 3) Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
  - 4) Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
  - 5) Minimum Connection Size: NPS 1.
  - 6) Pan-Top Surface Coating: Asphaltic waterproofing compound.
  - h. Air Filtration Section:
    - 1) General Requirements for Air Filtration Section:
      - a) Comply with NFPA 90A.
      - b) Minimum MERV according to ASHRAE 52.2.
      - c) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
    - 2) Disposable Panel Filters:
      - a) Factory-fabricated, viscous-coated, flat-panel type.
      - b) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
    - 3) Extended-Surface, Disposable Panel Filters:
      - a) Factory-fabricated, dry, extended-surface type.
      - b) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.
- C. Outdoor Units (5 tons (18 kW) or Less:
1. Air-Cooled, Compressor-Condenser Components:
    - a. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
    - b. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
      - 1) Compressor Type: Scroll.
      - 2) Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
      - 3) Refrigerant: R-32.
      - 4) Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
    - c. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
    - d. Fan: Aluminum-propeller type, directly connected to motor.
    - e. Motor: Permanently lubricated, with integral thermal-overload protection.
    - f. Low Ambient Kit: Permits operation down to 45 deg F.
    - g. Mounting Base: Polyethylene.
- D. Accessories
1. Control equipment and sequence of operation are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 23 09 93 "Sequence of Operations for HVAC DDC."
  2. Thermostat:
    - a. Low voltage with subbase to control compressor and evaporator fan.
    - b. Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
      - 1) Compressor time delay.
      - 2) 24-hour time control of system stop and start.
      - 3) Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
      - 4) Fan-speed selection including auto setting.
  3. Automatic-reset timer to prevent rapid cycling of compressor.
  4. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
  5. Drain Hose: For condensate.
  6. Monitoring:
    - a. Monitor constant and variable motor loads.
    - b. Monitor variable-frequency-drive operation.
    - c. Monitor economizer cycle.
    - d. Monitor cooling load.

- e. Monitor air distribution static pressure and ventilation air volumes.
- E. Capacities and Characteristics
  - 1. Cooling Capacity:
  - 2. See schedule.
  - 3. Heating Capacity:
    - a. Type: Electric.
    - b. Total Capacity: See schedule.
    - c. Electric Heating Coil:
      - 1) See schedule.
  - 4. Indoor Unit:
    - a. Fan Motor Electrical Characteristics:
      - 1) See schedule.
      - 2) Hertz: 60.
    - b. Airflow: See schedule.
  - 5. Outdoor Unit:
    - a. Type: Air cooled.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07 72 00 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
  - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
  - 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
  - 4. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

#### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
  - 1. Water Coil Connections: Comply with requirements specified in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
  - 2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 33 00 "Air Duct Accessories."

#### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

- B. Perform tests and inspections.
    - 1. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
  - C. Tests and Inspections:
    - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
    - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - D. Remove and replace malfunctioning units and retest as specified above.
  - E. Prepare test and inspection reports.
- 3.4 STARTUP SERVICE
- A. Perform startup service.
    - 1. Complete installation and startup checks according to manufacturer's written instructions.
    - 2.
- 3.5 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

## SECTION 23 84 13.29

### SELF-CONTAINED STEAM HUMIDIFIERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Self-contained electric-resistance humidifiers.
  - 2. Self-contained electrode humidifiers.
  - 3. Self-contained gas-fired humidifiers.
  - 4. Condensate drain coolers.

##### 1.2 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, distributor tubes/manifolds, and attachments to other work.
  - 1. Include diagrams for power, signal, and control wiring.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members to which humidifiers will be attached.
  - 2. Size and location of initial access modules for acoustical tile.
- B. Seismic Qualification Data: Certificates, for humidifiers, accessories, and components from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.

##### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.

##### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Supply one replacement electrode cylinder with each self-contained humidifier.

##### 1.8 COORDINATION

- A. Coordinate location and installation of humidifiers with distributor tubes/manifolds in ducts and plenums or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with AHRI 640.
- C. Comply with UL 998.
- D. Listed and labeled by, as complying with applicable AGA/CGA standards.
- E. Listed and labeled by ETL.
- F. Seismic Performance: Self-contained steam humidifiers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.5.
  - 3.
- G. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.

### **2.2 SELF-CONTAINED ELECTRODE HUMIDIFIERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Nortec Industries Inc.
- B. Capacities and Characteristics:
- C. See schedule.
- D. Water Type: Suitable for use with tap water.
- E. Cylinders: Replaceable or cleanable plastic humidifier water reservoir, steel electrode assembly, suitable for use with tap water.
- F. Cabinet:
  - 1. Baked-enamel, Powder-coated-steel, or stainless-steel enclosure houses heater cylinder, electrical wiring, components, controls, and control panel. Cabinet is factory insulated for safe operating surface temperature.
  - 2. Hinged or removable cover, keyed to restrict unauthorized access.
  - 3. Plumbing and electrical components housed in separate compartments of the cabinet.
  - 4. Threaded outlet in bottom of cabinet for drain piping.
- G. Weatherproof Outdoor Enclosure: Insulated, with automatically controlled heating and ventilating system to maintain minimum operating conditions within the enclosure.
- H. Control Panel:
  - 1. Microprocessor-based control system for modulating cycling control.
  - 2. Factory-wired disconnect switch.
  - 3. Liquid-crystal display.
  - 4. Programmable keypad.
  - 5. Low-voltage control circuit.
  - 6. Diagnostic, maintenance, alarm, and status features.
  - 7. Safety switch interlocked to shut off heaters when cabinet is open.
  - 8. Internal electrical controls prewired to appropriately marked terminals for field connection.
  - 9. Electrical terminals for connection to each controlling device and alarm.
  - 10. NEMA 250, Type 3R, to comply with environmental conditions at installed locations.
  - 11. Building Automation System Interface:
    - a. Full communication interface: BACnet.
    - b. Web-based remote factory online monitoring with same functionality as local keypad/display.



- I. Controls:
  - 1. Solenoid fill valve and automatic drain valve or drain pump maintain water level. Include bronze inlet strainer, bronze solenoid fill valve with flow regulator, bronze solenoid drain valve or drain pump, and fill tee with built-in air gap to prevent back siphoning.
  - 2. Controls shall drain tanks if no demand for humidification for more than 72 hours.
  - 3. Set-point adjustment.
  - 4. Electrode current shutdown upon sensing unsafe condition (e.g., drain system malfunction, fill system malfunction, or overcurrent malfunction).
  - 5. Tri-conductivity sensor probes for water-level control.
  - 6. Foaming detection and correction.
- J. Area Dispersion Accessory: Stainless-steel tube, with integral fan that discharges vapor directly into occupied space. Designed for integral mounting onto humidifier cabinet.
- K. Atmospheric Steam Distributer Tube(s): Single or multiple, atmospheric steam distributer tube extending across entire width of duct or plenum and equipped with mounting brackets on ends. Nozzles/metered orifices are spaced evenly along distributer tubes and provide dry and uniform steam distribution.
  - 1. Material: Stainless steel.
  - 2. Insulation: Insulated.
- L. Atmospheric Steam Panel Distribution Manifold:
  - 1. Prefabricated steam dispersion grid assembly.
  - 2. Designed for short absorption distance.
  - 3. Suitable for atmospheric steam applications.
  - 4. Extending the full width and height of duct or plenum.
  - 5. Horizontal header with multiple vertical or horizontal tubes designed for dry steam injection within short absorption distance.
  - 6. Nozzles/metered orifices, spaced evenly along distribution tubes, provide dry and uniform steam distribution.
  - 7. Distribution panel extending the full width and height of duct or plenum.
  - 8. Headers and Distribution Tubes:
    - a. Material: Stainless steel.
    - b. Insulation: Insulated.
  - 9. Steam Separator: Separators/baffles, integral to the header, provide condensate-free steam to distribution tubes.
- M. Accessories:
  - 1. Humidistat Humidity Sensor: Wall mounted.
  - 2. Airflow switch prevents humidifier operation without airflow.
  - 3. Steam and Condensate Hoses: For interconnection of humidifier to distributer tube(s)/manifold.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install humidifiers with required clearance for service and maintenance. Maintain path, downstream from humidifiers, clear of obstructions as required by ASHRAE 62.1.
- B. Seal all duct and plenum penetrations with flange.
- C. Install humidifier assemblies in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- D. Install galvanized-steel drain pan under each manifold mounted in duct.
  - 1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
  - 2. Connect to condensate trap and drainage piping.

3. Extend drain pan upstream and downstream from tube(s)/manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.
  - E. Install tube(s)/manifold supply piping pitched to drain condensate back to humidifier or as recommended by manufacturer.
  - F. Equipment Mounting:
    1. Install floor-mounted humidifiers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
    2. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
    3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."
  - G. Install gas-fired steam generators according to NFPA 54.
  - H. Install all manufacturer-furnished accessories in accordance with manufacturer's written installation instructions.
- 3.3 PIPING CONNECTIONS
- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
    1. Install piping adjacent to humidifiers to allow service and maintenance.
    2. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.
  - B. Install piping specialties furnished by manufacturer but not factory mounted.
  - C. Install piping from safety relief valves to nearest floor drain.
  - D. Connect gas piping full size to steam-generator, gas-train inlet with union. Gas piping materials and specialties are specified in Section 23 11 23 "Facility Natural-Gas Piping."
  - E. Connect breeching full size to steam-generator outlet. Venting materials are specified in Section 23 51 23 "Gas Vents."
  - F. Connect combustion-air inlet to intake terminal using PVC piping with solvent-cemented joints. Run from boiler connection to outside and terminate adjacent to flue termination.
- 3.4 ELECTRICAL CONNECTIONS
- A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
  - B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
  - C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
    1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
    2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.
    3. Locate nameplate where easily visible.
- 3.5 CONTROL CONNECTIONS
- A. Install control and electrical power wiring to field-mounted control devices.
  - B. Connect control wiring between control devices.
  - C. Connect control wiring according to Section 26 05 23 "Control Voltage Electrical Power Cables."
- 3.6 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
  - C. Perform the following tests and inspections with the assistance of a factory-authorized service agent:
    1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Humidifier will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- 3.7 DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.

END OF SECTION 23 84 13.29

**SECTION 26 05 00**

**COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
1. Electrical equipment coordination and installation.
  2. Sleeves for raceways and cables.
  3. Fire Rated Sleeves for cables.
  4. Grout.
  5. Common electrical installation requirements.
  6. Utility company coordination requirements.

1.2 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
1. A: Ampere, unit of electrical current.
  2. AC or ac: Alternating current.
  3. AF : Amp Frame
  4. AFCI: Arc-fault circuit interrupter.
  5. AIC: Ampere interrupting capacity.
  6. AL, Al, or ALUM: Aluminum.
  7. AP: Wireless access point
  8. ASD: Adjustable-speed drive.
  9. AT: Amp Trip
  10. ATS: Automatic transfer switch.
  11. AV: Audio-Video, audio-visual
  12. AWG: American wire gauge; see ASTM B258.
  13. BAS: Building automation system.
  14. BIL: Basic impulse insulation level.
  15. BIM: Building information modeling.
  16. BJ: Bonding jumper
  17. BKR: Breaker
  18. BMS: Building Management System
  19. C: Conduit
  20. CAD: Computer-aided design or drafting.
  21. CATV: Community antenna television, Cable Television
  22. CB: Circuit breaker.
  23. CCTV: Closed circuit television
  24. CFCI: Contractor furnished contractor installed
  25. CKT: Circuit
  26. CU or Cu: Copper.
  27. CU-AL or AL-CU: Copper-aluminum.
  28. dB or DB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
  29. DC or dc: Direct current.
  30. DDC: Direct digital control (HVAC).
  31. DISC: Disconnect
  32. DP: Distribution Panelboard
  33. DW: Dishwasher
  34. ECS: Emergency communication system
  35. EGB: Electrical grounding busbar
  36. EGC: Equipment grounding conductor.
  37. EMD: Estimated maximum demand.
  38. EMGB: Electrical main grounding busbar
  39. EMI: Electromagnetic interference.
  40. EP: Explosion proof
  41. EPS: Emergency power supply.

42. EPSS: Emergency power supply system.
43. ER: Existing to be relocated
44. ERMS: Energy reduction maintenance switch
45. ESS: Energy storage system.
46. EV: Electric vehicle.
47. EWC: Electric water cooler
48. FA: Fire Alarm
49. FAA: Fire alarm annunciator
50. FACP: Fire alarm control panel
51. FC or fc: Footcandle, a unit of illuminance equal to one lumen per square foot.
52. FLA: Full load amps
53. FLC: Full-load current.
54. FS: Flow Switch
55. FSD: Fire smoke damper
56. ft.: Foot.
57. G or GND: Equipment grounding conductor
58. GEC: Grounding electrode conductor.
59. GEN: Generator
60. GFI or GFCI: Ground-fault circuit interrupter.
61. GFPE: Ground-fault protection of equipment.
62. GND: Ground.
63. HACR: Heating, air conditioning, and refrigeration.
64. HDPE: High-density polyethylene.
65. HID: High-intensity discharge.
66. HH: Handhole
67. HOA: Hand-off-automatic
68. HP or hp: Horsepower.
69. HVAC: Heating, ventilating, and air conditioning.
70. Hz: Hertz.
71. IC: Intercom
72. IG: Isolated ground.
73. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
74. IP: Ingress protection rating (enclosures); Internet protocol (communications).
75. IR: Infrared.
76. IS: Intrinsically safe.
77. ITE: Information technology equipment.
78. JB: Junction Box
79. KAIC or kAIC: Kiloampere interrupting capacity.
80. kcmil or MCM: One thousand circular mils.
81. KV or kV: Kilovolt.
82. KVA or kVA: Kilovolt-ampere.
83. kVAr or kVAR: Kilovolt-ampere reactive.
84. KW or kW: Kilowatt.
85. kWh: Kilowatt-hour.
86. LAN: Local area network.
87. LT: Light
88. LTG: Lighting
89. lb: Pound (weight).
90. LCD: Liquid-crystal display.
91. LED: Light-emitting diode.
92. LRC: Locked-rotor current.
93. MCA: Minimum circuit ampacity
94. MCB: Main circuit breaker
95. MCC: Motor-control center.
96. MDC: Modular data center.
97. MG set: Motor-generator set.
98. MH: Manhole
99. MLO: Main lugs only.
100. MOCP: Maximum overcurrent protection
101. MRTS: Motor rated toggle switch
102. MSB: Main switchboard
103. MTD: Mounted

- 104. MTG: Mounting
- 105. MTS: Main transfer switch
- 106. MVA: Megavolt-ampere.
- 107. mW: Milliwatt.
- 108. MW: Megawatt.
- 109. MWh: Megawatt-hour.
- 110. N: Neutral
- 111. N.C. or NC: Normally closed.
- 112. NF: Non-fused
- 113. NiCd: Nickel cadmium.
- 114. NL: Night light.
- 115. N.O. or NO: Normally open.
- 116. OCPD: Overcurrent protective device.
- 117. OFCI: Owner furnished contractor installed.
- 118. ONT: Optical network terminal.
- 119. P: Pole – referring to an electrical position in a panel
- 120. PA: Public address
- 121. PB: Pull box
- 122. PC: Personal computer.
- 123. PF or pf: Power factor.
- 124. PH or ph: Phase
- 125. PIV: Post indicator valve.
- 126. PLC: Programmable logic controller.
- 127. PoE: Power over Ethernet.
- 128. PVC: Polyvinyl chloride.
- 129. RCP: Reflected ceiling plan.
- 130. RECPT: Receptacle.
- 131. REF: Reference.
- 132. RFI: Radio-frequency interference (electrical); Request for interpretation (contract).
- 133. RMS or rms: Root-mean-square.
- 134. RPM or rpm: Revolutions per minute.
- 135. SCADA: Supervisory control and data acquisition.
- 136. SCCR: Short circuit current rating.
- 137. SEC: Secondary.
- 138. SPD: Surge protective device.
- 139. sq.: Square.
- 140. SWD: Switching duty.
- 141. SWBD: Switchboard.
- 142. TBB: Telecommunications bonding backbone.
- 143. TC: Time clock.
- 144. TCP/IP: Transmission control protocol/Internet protocol.
- 145. TGB: Telecommunications grounding busbar.
- 146. TMGB: Telecommunications main grounding busbar.
- 147. TO: Telecommunications outlet.
- 148. TR: Telecommunications room.
- 149. TR: Tamper resistant.
- 150. TS: Tamper switch.
- 151. TV: Television.
- 152. TVSS: Transient voltage surge suppressor.
- 153. UG : Underground.
- 154. UL: Underwriters Laboratories, Inc. (standards) or UL LLC (services).
- 155. UPS: Uninterruptible power supply.
- 156. USB: Universal serial bus.
- 157. UV: Ultraviolet.
- 158. V: Volt, unit of electromotive force.
- 159. Vac or V(ac): Volt, alternating current.
- 160. Vdc or V(dc): Volt, direct current.
- 161. VA: Volt-ampere, unit of complex electrical power.
- 162. VAR or VAR: Volt-ampere reactive, unit of reactive electrical power.
- 163. VFC: Variable-frequency controller.
- 164. VFD: Variable-frequency drive.
- 165. VPN: Virtual private network.

- 166. VRLA: Valve-regulated lead acid.
- 167. W: Watt, unit of real electrical power or Wire.
- 168. WG: Wire guard.
- 169. Wh: Watt-hour, unit of electrical energy usage.
- 170. WP: Weather proof.
- 171. WR: Weather resistant.
- 172. XFMR: Transformer.

### 1.3 DEFINITIONS

- A. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- B. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- C. "Provide": Furnish and install, complete and ready for the intended use.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For Fire Rated Sleeves for cables.
  - 1.

### 1.5 COORDINATION

- A. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittal.
- B. Location of electrical outlets and equipment:
  - 1. Location of electrical outlets and equipment shown on electrical drawings are diagrammatic. Unless indicated otherwise do not use electrical drawings to locate electrical outlets and equipment.
  - 2. Luminaires and outlets:
    - a. Ceiling mounted luminaires and outlets: use architectural reflected ceiling plans and details to determine location unless indicated otherwise.
    - b. Wall mounted luminaires and outlets:
      - 1) Use architectural elevation and section drawings to determine location unless indicated otherwise.
      - 2) Where architectural elevation and section drawings do not indicate location of wall outlets then locate the outlet within 12 inches of location shown on electrical drawings considering field conditions.
      - 3) Coordinate location with consideration of owner provided equipment such as wall mounted televisions, white boards, furniture, cabinets and the like.
    - c. Floor mounted outlets: use architectural drawings to determine location unless indicated otherwise. If not clearly indicated, then send request for information to Architect.
    - d. Cabinet mounted luminaires and outlets: use cabinet details and shop drawings to determine location unless indicated otherwise.
    - e. Exterior luminaire poles and bollards: use locations indicated on electrical site plans and civil plans unless indicated otherwise
  - 3. Electrical equipment: Utilize approved manufacturer's shop drawing dimensions to determine location of equipment in space. Comply with NEC 110.26 access, working space and dedicated equipment space requirements. Maintain manufacturer requirements for maintenance access.
  - 4. Electrical handholes and manholes: use location shown on electrical site plans unless indicated otherwise.
  - 5. Outdoor Electrical equipment: use location shown on electrical site plans unless indicated otherwise.
- C. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification sections for additional requirements for shop drawings outside of these requirements.
- D. Electrical connections to equipment supplied by owner or other trades:
  - 1. Prior to procurement of electrical equipment and field work coordinate with shop drawings and/or manufacturer's installation instructions the actual electrical characteristics of the equipment to be connected.

2. Notify engineer of significant deviations or conflicts between the shop drawings and/or the manufacturer's installation instructions and information in the contract documents.
- E. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope so connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- F. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- G. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Section 08 31 13 "Access Doors and Frames."
- H. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 07 84 13 "Penetration Firestopping."
- I. Coordinate and install wiring for appliances and systems furnished under other specification Divisions or furnished by the Owner. Install electrical wiring in accordance with manufacturer's instructions.:
1. Motorized door operators.
  2. Electric water coolers.
  3. Exterior signage.
  4. Owner provided equipment
- 1.6 PERMITS AND FEES
- A. Obtain and pay all fees for permits, licensing, and inspections applicable to work of Division 26, 27 and 28
- 1.7 QUALITY ASSURANCE
- A. Regulatory Requirements: Install work and materials to conform with local, State and Federal codes, and other applicable laws and regulations.
- B. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. Drawings are not intended to show every item in its exact location, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Provide Qualified Personnel that are thoroughly knowledgeable of applicable codes related to electrical systems to perform the electrical work. Installations shall be performed by skilled electrical tradesmen fully aware of the latest techniques, practices, and standards of the industry. Refer to N.E.C. Article 100-Definitions, Qualified Person.
- F. Install electrical equipment and components in a neat and workmanlike manner in accordance with recognized practices and industry standards. Refer to N.E.C.110-12. Haphazard or poor installation practice will be cause for rejection of the work.



## **PART 2 - PRODUCTS**

### **2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT**

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
  - 1. Substitution requests may be submitted for consideration if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
  - 2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
  - 3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. Insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

### **2.2 SLEEVES FOR RACEWAYS AND CABLES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.
- C. EMT: Electrical Metallic Tubing.
- D. PVC: Schedule 40 or 80.

### **2.3 FIRE RATED SLEEVES FOR CABLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M
  - 2. Hilti
  - 3. Specified Technologies, Inc (STI)
  - 4. Wiremold.
- B. Factory assembled rectangular steel pathway containing an intumescent insert material that adjusts automatically to cable addition or subtraction.
- C. Sleeve shall have an F Rating equal to or greater than the rating of the wall in which the sleeve is installed.
- D. Sleeve shall be UL listed and bear the UL Classification marking.
- E. Sleeve shall be tested in accordance with ASTM E814 (ANSI/UL1479).
- F. Provide square wall plate kits for single sleeve applications. Provide multi-gang wall/floor plate kits for ganged applications.
- G. Subject to compatibility with requirements and field conditions, i.e. sleeve size, wall thickness, etc., acceptable products include the following:
  - 1. 3M Fire Barrier Pass-Through Devices
  - 2. Hilti Speed Sleeves
  - 3. Specified Technologies Inc. EZ-Path Fire Rated Pathway (series 33).
  - 4. Wiremold Flamestopper FS4 Series

### **2.4 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF ELECTRICAL WORK**

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.
- B. Comply with NECA 1.
- C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Give to piping systems installed at a required slope.

#### **3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete, masonry and gypsum board walls, or fire-rated floor and wall assemblies.
- B. Sleeves are required where cables (not in raceway) penetrate walls or floors. Sleeves are not required where raceways penetrate walls, except where raceways penetrate exterior walls/foundations below grade.
- C. Concrete Slabs and Walls: Install sleeves during erection of slabs and walls.
- D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Provide insulated bushings on EMT sleeves for cable not in conduit. Bushings shall be plenum rated where installed in a plenum.
- G. Extend sleeves installed in floors 4 inches above finished floor level unless noted otherwise.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe or PVC, schedule 40 or 80, sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve. Cut sleeves to length for mounting flush with both surfaces of walls.
- M. Fire Rated Sleeves for cables: Fabricate openings in wall or floor assemblies per manufacturer's recommendations.

#### **3.3 SLEEVE APPLICATION**

- A. Sleeves for cables not in conduit:
  - 1. Through Non-Rated Interior Walls: EMT sleeves.
  - 2. Through Non-Rated Floors: EMT sleeves.
  - 3. Through Fire Rated Interior Walls: Fire Rated Sleeves for cables.
  - 4. Through Fire Rated Floors: Fire Rated Sleeves for cables.

- B. Sleeves for conduits:
  - 1. Through Exterior Walls Below Grade: Refer to details on structural Drawings. Absent any such details provide cast iron pipe or PVC, Schedule 40 or 80, sleeve two trade sizes larger than the conduit.
- C. Sleeves for Cable Trays:
  - 1. Through Non-Rated Interior Walls: Rectangular galvanized sheet metal opening.
  - 2. Through Fire Rated Walls: Stop cable tray 6 inches maximum for each side of wall and provide multiple fire rated sleeves for cables with combined allowable area for cable equal to the capacity of the cable tray unless noted otherwise.

#### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section 07 84 13 "Penetration Firestopping."

END OF SECTION 26 05 00

## SECTION 26 05 03

### DEMOLITION OF ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Demolition and removal of selected portion of electrical systems, including special systems normally specified in Division 27 and 28.
  - 2. Salvage of existing items to be reused.
  - 3. Salvage of existing items to be delivered to the Owner.

##### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

##### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Remove and salvage items noted as 'salvage', 'return to Owner' or similar manner on the Drawings.
- C. Remove and salvage items as requested by the Owner. Conduct a meeting with the Owner prior to commencing demolition to determine items that the Owner wishes to retain.

##### 1.4 PRE-TESTING

- A. Prior to commencing work, perform testing of devices and systems to verify devices and systems to remain are in good working condition. Devices shall include wiring devices and lighting control devices. Systems shall include, but is not limited to, fire alarm, and intercom.
- B. Prepare a type written report documenting any items found to be damaged or in a non-working condition. Submit report to the Owner and Architect prior to commencing work. All devices and systems shall be considered in good working conditions if a report is not submitted and acknowledged by the Owner prior to commencing work.
- C. Arrange a time to perform testing with the Owner with at least two weeks advanced notice.
- D. Existing Branch Circuits that Remain: Trace and ring-out existing branch circuits. Update panel schedules and relabel outlets, disconnect switches, boxes, and the like with actual branch circuit designations. Include such information in record drawings.
- E. Where infrared scanning results indicate excessive heat, tighten the mechanical lugs and retest after 24 hours.
- F. Include testing reports for above in closeout documentation. Record measurements and actions taken.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

**3.1 ELECTRICAL SYSTEMS DEMOLITION**

- A. Remove items depicted or denoted for demolition on the Drawings. Unless noted otherwise, removal of the items shall include devices, boxes, cable, supporting elements, raceway, etc. associated with the item back to the panelboard or nearest j-box or device to remain.
- B. Drawings are intended to indicate the general scope of demolition work. Visit the Project site to verify existing conditions prior to bidding. Determine means and methods for performing work. Identify existing building finishes, ceiling types, access, and fire walls. Determine locations, routings, and distances as necessary. Coordinate with the Owner to gain access to the facility.
  - 1. Wherever walls, ceilings, structures, or electric-powered equipment are indicated as being removed on the Drawings (including architectural demolition plans and mechanical demolition plans) remove associated electrical system components, equipment, devices, fixtures, raceways, and wiring. Remove, relocate, and extend existing installations, as necessary, to accommodate demolition work, new work, and to maintain the existing electrical installations that shall remain operational. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
  - 2. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
  - 3. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories
- C. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to loads that remain in operation (i.e., facilities, luminaires, wiring devices, equipment, etc.). Extension of conduit and wire to equipment shall be compatible with the surrounding area.
  - 1. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel and/or junction boxes where appropriate.
  - 2. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.
- D. Where existing conduits and/or cables, which remain in service, pass through areas to be renovated and where such conduits and/or cables interfere with new work, reroute these conduits and/or cables to avoid new construction. Provide necessary boxes, cables, splicing and fittings for the rerouting of the circuits. Field-verify to determine complete scope of work prior to bidding.
- E. Existing conduit may remain if all the following are true:
  - 1. Conduit will be reused to feed items installed under this contract.
  - 2. Conduit does not interfere with other trades.
  - 3. Conduit was originally installed meeting specifications related to this project.
  - 4. Conduit will not be exposed in a finished area (unless noted otherwise).
- F. Provide plugs on boxes to remain where conduits have been removed.
- G. Conduits concealed in masonry walls or under concrete slabs may be cut back, sealed and abandoned.
- H. Provide blank cover-plates on all abandoned boxes to remain in existing masonry or stud walls. Plate color and material shall match wiring devices plates specified for the project. In the absence of such specification, match the color and material of existing wiring devices in the area.
- I. Maintain power to end-of-line or downstream devices to remain. Provide raceways, boxes, conductors and all other necessary materials as required to re-establish damaged or interrupted feeders and branch circuits. Intercept existing feeders or branch circuits at nearest accessible space or device and reconnect to original feeder or branch circuit source.
- J. Repair or replace ceilings, ceiling tiles, and ceiling-grids that are damaged by this contractor.
- K. Electrical installations that remain shall be concealed, unless otherwise indicated or unless located within unfinished utility-type spaces. Cut and patch existing walls and ceilings as required. Exposed conduits and raceways will be rejected, unless prior approval has been obtained. Confirm scope of work and specific requirements for all such work directly with the Owner and the Architect.
- L. Prior to drilling existing precast concrete walls, detect and locate existing structural members imbedded within the precast panels to ensure they are not damaged.

3.2 SPECIAL SYSTEMS DEMOLITION

- A. Remove items depicted or denoted for demolition on the Drawings. Unless noted otherwise, removal of the items shall include devices, boxes, cable, supporting elements, etc. associated with the item back to the control panel, terminal block, punch block, patch panel, or similar type of termination point.

3.3 REMOVED MATERIALS

- A. Existing wiring removed shall be regarded as scrap materials to be recycled by this contractor. Scrap value shall be determined by the contractor and accounted for in the contractor's bid.
  - 1. All other demolished electrical items (e.g., power panels, luminaires, receptacles, switches, controllers, system devices, etc.) shall be regarded as the Owner's property. The Owner reserves the right to identify which items shall be salvaged—and, thus, carefully removed by this contractor and placed in storage on site as directed by the Owner. The contractor shall be responsible for the proper disposal of all demolished materials that the Owner does not want to salvage. Coordinate specific requirements directly with Owner.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
  - 1. Ballasts in luminaires installed prior to 1980 shall be incinerated in EPA approved incinerator or disposed of in EPA certified containers and deposited in an EPA landfill certified for PCB disposal or recycled by permitted ballast recycler. Punctured or leaking ballasts must be disposed of according to Federal Regulations under the Toxic Substance Control Act. Provide to Owner and architect/engineer with a Certificate of Destruction to verify proper disposal.
  - 2. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in a permitted hazardous waste disposal facility or by a permitted lamp recycler.

END OF SECTION 26 05 03

## SECTION 26 05 19

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Aluminum building wire rated 600 V or less.
  - 3. Metal-clad cable, Type MC, rated 600 V or less
  - 4. Cord Products
  - 5. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
  - 1. Section 26 05 33 "Raceway and Boxes for Electrical Systems" for allowable applications of raceways and cable assemblies. Cable assemblies, such as Type MC cable, shall not be permitted unless noted otherwise.
  - 2. Section 26 05 53 "Identification for Electrical Systems" for conductor color coding.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### PART 2 - PRODUCTS

##### 2.1 BUILDING WIRE

- A. Copper Building Wire
  - 1.
  - 2. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
  - 3. Conductors: complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- B. Aluminum Building Wire
  - 1. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
  - 2. Conductors: 8000 series electrical grade aluminum alloy, complying with ASTM B800 and ASTM B801.
  - 3. Permitted for feeders greater than 100 amps only.
  - 4. Aluminum building wire shall not be used for connections to any equipment that has not been used UL tested with aluminum building wire connections or where such connection will void or reduce the manufacturer's warranty. Such equipment may include HVAC equipment and elevators.
  - 5. Not permitted for motor feeders or branch circuits.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
  - D. Conductor Insulation:
    1. Type THHN and Type THWN-2: Comply with UL 83.
    2. Type XHHW-2: Comply with UL 44.
  - E. Temperature Ratings: All conductors shall be rated 75-degree C minimum.
- 2.2 METAL-CLAD CABLE, TYPE MC
- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
  - B. Standards:
    1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
    2. Comply with UL 1569.
    3. RoHS compliant.
  - C. Circuits:
  - D. Single circuit. Separate neutral conductors shall be included for each circuit originating from a unique overcurrent protection device.
  - E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
  - F. Ground Conductor: Insulated.
  - G. Conductor Insulation:
    1. Type THHN/THWN-2: Comply with UL 83.
    2. Type XHHW-2: Comply with UL 44.
  - H. Armor: Steel or Aluminum, interlocked.
  - I. Jacket: PVC applied over armor.
- 2.3 CORD PRODUCTS
- A. Description: Flexible, hard-use service cord with black rubber jacket. Type SO, SOW, etc.
  - B. Circuits: Single circuit and multi-circuit with color coded conductors. Separate neutral conductors shall be included for each circuit originating from a unique overcurrent protection device.
  - C. Conductors: Copper, complying with ASTM B8 for stranded conductors.
  - D. Ground Conductor: Insulated.
  - E. Conductor Insulation:
    1. Type THHN/THWN-2: Comply with UL 83.
- 2.4 CONNECTORS AND SPLICES
- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
  - C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
    1. Lugs for attachment to telecommunications systems grounding busbars shall be two-hole with long barrels and irreversible crimp terminations.

### **PART 3 - EXECUTION**

- 3.1 CONDUCTOR MATERIAL APPLICATIONS
- A. Feeders:
    1. 100 amps and less: Copper, stranded.
    2. Over 100 amps: Copper or aluminum, stranded.



- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
- A. Feeders to Distribution Equipment and Panelboards: Type XHHW-2, single conductors in raceway.
  - B. Exterior Feeders and branch circuits routed horizontally on roofs: Type XHHW-2, single conductors in raceway.
  - C. Other Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.
  - D. Feeders connected from the load-side of VFDs to electric motors: Type XHHW-2 single conductors installed in a raceway or Type XHHW-2 MC cable where permitted.
  - E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
  - F. Metal Clad Cable
    - 1. Uses permitted:
      - a. Branch circuits rated less than 50 amps
      - b. In areas that have accessible ceiling space
    - 2. Uses not permitted:
      - a. Feeders
      - b. Homeruns.
      - c. Areas where there is no access to the ceiling space
      - d. Areas that have no ceiling or exposed structure
      - e. Exposed
      - f. Wet or damp areas
- 3.3 CONDUCTOR SIZES
- A. Minimum Wire Size (Interior Work): No. 12 AWG, except No. 14 AWG shall be permitted for signal, pilot control circuits and fixture whips.
  - B. Minimum Wire Size (Exterior Work): No 10 AWG.
  - C. Use #10 AWG minimum conductor size in lieu of #12 AWG minimum for 20 ampere, 120 volt branch circuits where homeruns are longer than 75 feet and for 20 ampere, 277 volt branch circuits where homeruns are longer than 175 feet. Increase in size as required for a maximum of 3 percent voltage drop from panel to load.
  - D. Derate conductors based on quantity of current carrying conductors in each conduit. Refer to the NEC for derating factors.
  - E. Derate conductors for high ambient temperatures. Refer to the NEC for derating factors.
- 3.4 INSTALLATION OF CONDUCTORS AND CABLES
- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
  - B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
  - C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
  - D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
  - E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
  - F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
  - G. Branch circuits serving receptacles and lighting loads shall have dedicated neutral conductors and shall not share a common neutral conductor. The use of handle ties across single pole circuit breakers to allow the use of a common neutral is not acceptable.

- H. Multiwire Branch Circuits and Shared Neutrals:
  - 1. Multiwire branch circuits (as defined by the NEC) and shared neutrals (common grounded conductors) are not permitted, except as follows:
    - a. Wherever a multiwire branch circuit is specifically indicated on the Drawings and a multi-pole breaker is provided in the panel from which it originates as a means to simultaneously disconnect all ungrounded conductors.
  - 2. Derating factors shall be applied, per NEC Article 310, to multiple current-carrying conductors installed within the same conduit. Neutral conductors shall be regarded as current-carrying conductors. Wire sizes shall be increased as needed to maintain the ampacity that corresponds to the overcurrent protection device rating.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepared test reports.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors 100 amps and larger for compliance with requirements:
  - 3. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

## SECTION 26 05 26

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Photographic evidence of underground electrode(s) installation.
- C. Dimension drawings showing locations of test wells, grounding electrodes, ground rods, ground ring and connections to steel.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
      - 1) Test wells.
      - 2) Ground rods.
      - 3) Ground rings.

##### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

#### PART 2 - PRODUCTS

##### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

##### 2.2 ELECTRICAL GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Chatsworth.
  - 2. Cooper B-Line.
  - 3. Erico.
  - 4. Harger.
- B. Products shall be UL listed.
- C. Copper busbar, 0.25-inch thick minimum, insulated stand-offs, factory predrilled standard size holes.
- D. Electrical Grounding Busbars: Height shall be 4-inches minimum and length shall be 24-inches minimum unless indicated otherwise on Drawings.
- E. Connector Lugs: Lugs for connecting to grounding electrode conductors and bonding conductors shall be UL listed two-hole, long barrel, electro tinplated compression lugs.

### 2.3 TELECOMMUNICATIONS GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line
  - 2. Chatsworth
  - 3. Erico.
  - 4. Harger
  - 5. Legrand Ortronics
  - 6. Panduit
- B. Products shall be UL listed meet the specification of TIA/EIA 607 and conform to BICSI recommendations.
- C. Copper busbar, 0.25-inch thick minimum, insulated stand-offs, factory predrilled standard size holes per TIA/EIA 607 standard.
- D. Telecommunications Main Grounding Busbars: Height shall be 4-inches. Length shall be 20-inches minimum unless indicated otherwise on Drawings. Chatsworth 40153 series or equal.
- E. Telecommunications Grounding Busbars: Height shall be 2-inches. Length shall be 10-inches minimum unless indicated otherwise on Drawings. Chatsworth 13622 series or equal.
- F. Connector Lugs: Lugs for connecting to telecommunications grounding busbars shall be UL listed two-hole, long barrel, electro tinplated compression lugs.

### 2.4 CONDUCTORS

- A. Insulated Conductors: tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B3.
  - 2. Stranded Conductors: ASTM B8.
  - 3. Tinned Conductors: ASTM B33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

### 2.5 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with zinc-plated bolts.
    - a. Material: Tin-plated aluminum.
    - b. Listed for direct burial.
  - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

### 2.6 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe..
- D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow
- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
- F. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

#### **3.2 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
  - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived systems or service unless otherwise indicated.

#### **3.3 TELECOMMUNICATIONS GROUNDING**

- A. Provide grounding in accordance with TIA 607 and as indicated on the Drawings.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. Use exothermic welds for all below-grade connections.
  - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  - 1. Install at least one test well for the ground ring. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations.
- F. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
  - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  - 2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

- K. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### 3.5 FIELD QUALITY CONTROL

- A. Prior to covering underground UFER grounds and connections to ground rods, take digital photographs of the grounding electrodes including conductor connections. Record locations of each photograph. Submit to A/E for documentation purposes.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances:
- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

## SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

- A. References
  - 1. Division 3 – Concrete Specifications
  - 2. Division 5 – Metals Specifications
- 1.2 SUMMARY
  - A. Section Includes:
    - 1. Steel slotted support systems.
    - 2. Conduit and cable support devices.
    - 3. Support for conductors in vertical conduit.
    - 4. Structural steel for fabricated supports and restraints.
    - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
    - 6. Fabricated metal equipment support assemblies.
- 1.3 SUBMITTALS
  - A. Submittals not required this Section
- 1.4 QUALITY ASSURANCE
  - A. Comply with NFPA 70
  - B. Welding Qualifications: Qualify procedures and personnel according to the following:
    - 1. AWS D1.1/D1.1M – Structural Welding Code - Steel.
    - 2. AWS D1.2/D1.2M – Structural Welding Code - Aluminum.
  - C. Applicable Specifications: Latest edition of following specifications and recommended practices shall become part of this specification as if written herein. Wherever requirements conflict, the more stringent shall govern.
    - 1. ACI 318, Appendix D/Chapter 17
    - 2. Mechanical Anchors: ACI 355.2, "Qualification of Post-Installed Mechanical Anchors in Concrete".
    - 3. Adhesive Anchors: ACI 355.4, "Qualification of Post-Installed Adhesive Anchors in Concrete".
  - D. All post-installed anchors in concrete shall
    - 1. Have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete and shall have seismic qualification to meet the project requirements.
    - 2. Special inspection, where required by code, shall be in accordance with a current published ICC-ES Evaluation Report (IBC 2012 Table 1705.3 Note B)
    - 3. Where material or equipment must be supported from the structure, the installer of that material or equipment support shall be responsible for supplying the anchors and meeting the requirements of this specification unless specifically noted otherwise on the plans.
- 1.5 STORAGE AND HANDLING
  - A. Keep post installed anchors, rod materials, nuts and washers in original manufacturer's packaging with label intact until needed for use. Keep anchors free of dirt and debris. Protect anchors from corrosion and deterioration. Store all anchoring products in strict accordance with manufacturer's recommendations. For adhesive anchors, consider temperature, exposure to sunlight, and shelf life.

### PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS
  - A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design hanger and support system.



## 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. Thomas & Betts Corporation.
    - e. Unistrut; Tyco International, Ltd.
    - f. Wesanco, Inc.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  4. Channel Width: Selected for applicable load criteria.
  5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
      - 6) DEWALT
    - b. Post Installed Anchoring Products for use in normal weight concrete, sand light weight concrete, concrete over metal deck and masonry
      - 1) Expansion Anchors:
        - a) DeWalt "Power-Stud+ SD1" (ICC-ES ESR 2818)
        - b) DeWalt "Power-Stud+ SD2" (ICC-ES ESR 2502)
        - c) DeWalt "Power-Stud+ SD4", Type 304 SS (ICC-ES ESR 2502)
        - d) DeWalt "Power-Stud+ SD6", Type 316 SS (ICC-ES ESR 2502)
        - e) Approved equal
      - 2) Screw Anchors:
        - a) DeWalt "Screw- Bolt+" (ICC-ES ESR 3889)
        - b) DeWalt "Snake+" Internally threaded (ICC-ES ESR 2272)
        - c) DeWalt "Hanger-Mate+" Internally threaded coupler (ICC-ES ESR 3889)
        - d) Approved Equal
      - 3) Adhesive Injection Systems:
        - a) DeWalt "Pure110+" Epoxy Adhesive, standard cure (ICC-ES ESR 3298)
        - b) DeWalt "AC200+" Acrylic Adhesive, fast cure (ICC-ES ESR 3889)
        - c) Approved Equal
      - 4) Cast-in-place Inserts:
        - a) DeWalt "Wood-Knocker II" Internally threaded (ICC-ES ESR 3657)
        - b) DeWalt "Bang-It" Internally threaded (ICC-ES ESR 3657)
        - c) DeWalt "DDI+" Headed Stud Specialty Insert (ICC-ES ESR 3958)
        - d) Approved Equal

- 5) Shallow Embedment Internally Threaded Insert (3/4" Max. Embedment)
  - a) DeWalt "Mini-Undercut+" (ICC-ES-ESR 3912)
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
5. Toggle Bolts: All -steel springhead type.
6. Hanger Rods: Threaded steel.

### 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA 101
- B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Damp or wet locations: Utilize hot dipped galvanized steel slotted support systems. Apply galvanizing-repair paint to comply with ASTM A780 on cut edges.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  6. To Light Steel: Sheet metal screws.
  7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.
- F. Installation of all post installed anchor products shall be conducted in strict accordance with the Manufacturer's Published Installation Instructions (MPII). Use hammer drills for adhesive anchors (unless noted otherwise).
- G. All post installed anchors shall be installed by an installer trained for that specific product by a manufacturer's field representative. All training must be conducted on the jobsite prior to the installation of any products. A record of training must be submitted to the EOR per the submittal instructions.
- H. All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 9.2.2. Current AAI Certificated must be submitted to the Engineer of Record for approval prior to commencement of any adhesive anchor installations.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 4500-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Comply with requirements in Section 09 91 23 "Interior Painting" and Section 09 96 00 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 05 29

## SECTION 26 05 33

### RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Surface raceways.
  - 4. Boxes.
  - 5. Handholes and boxes for exterior underground cabling.
  - 6. Seals
- B. Related Requirements:
  - 1. Section 07 84 13 "Penetration Firestopping" for firestopping at conduit and box entrances.
  - 2. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
  - 3. Section 26 05 19 "Low-Voltage Power Conductors and Cables" for cable assemblies such as metal clad cable. See part 3 in section 26 05 19 for application for metal clad cable.

##### 1.2 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, cabinets, and handholes.

#### PART 2 - PRODUCTS

##### 2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
  - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. GRC: Comply with ANSI C80.1 and UL 6.
  - 3. IMC: Comply with ANSI C80.6 and UL 1242.
  - 4. EMT: Comply with ANSI C80.3 and UL 797.
  - 5. FMC: Comply with UL 1; zinc-coated steel.
  - 6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
  - 1. Comply with NEMA FB 1 and UL 514B.
  - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
  - 4. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: compression.
  - 5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
  - 1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- B. Nonmetallic Fittings:
  - 1. Fittings, General: Listed and labeled for type of conduit, location, and use.
  - 2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  - 3. Below Grade Long Radius Elbows:
    - a. Conduits 2 inches to 2.5 inches: use minimum 24-inch radius Fiberglass Elbow.
    - b. Conduits larger than 2.5 inches: use minimum 36-inch radius Fiberglass Elbow.
  - 4. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MonoSystems, Inc.
    - b. Wiremold; Legrand North America, LLC.
    - c. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
  - 2. Two-Compartment Divided Surface Metal Raceway for Power and Data: UL Listed two-piece steel construction with baked-on powder-coat epoxy finish. Provide divider integral with base. Corner and T-fittings shall have a 2.5-inch (minimum) bend-radius to support CAT-6A communications cables.
    - a. Design Basis: Wiremold 4000 series with V4050 mounting brackets and V5507D faceplates for duplex receptacles. Provide wiring device brackets for low-profile mounting of standard duplex receptacles in-line with the raceway.
    - b. Device Spacing:
      - 1) Power Outlets (120V Duplex Receptacles): 30 inches on-center, unless otherwise indicated on the drawings.
      - 2) Toggle Switch: 120V, single pole toggle switch for control of circuit.
    - c. Include all components necessary for fully equipped, complete, and functional raceway system.
    - d. Color: Gray.

## 2.4 BOXES

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Metal Floor Boxes:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hubbell
    - b. ABB
    - c. Legrand/Wiremold
    - d. Steel City
    - e. FSR
  - 2. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Multi-Compartment Floor Boxes:
    - a. Provide multi-service shallow stamped steel recessed floor box, fully adjustable with feed-through tunneling to adjacent compartments.

- b. Duplex receptacles: provide as indicated on the drawings
  - c. Telecom jacks: provide as indicated on the drawings
  - d. Audio Visual connectors: provide as indicated on the drawings
  - e. Provide water resistant activation cover meeting UL scrub water exclusion requirement.
  - f. Basis of design Legrand/Wiremold RFB-SS series. See additional information on drawings.
  - g. Include all accessories for a complete installation.
  - h. Floor Box Cover Assembly:
    - 1) Carpet: Flanged lid, flat smooth surface with no inserts, die-cast aluminum with black finish. Flanged lid must be installed tight to floor—no exceptions.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep .
- I. Gangable boxes are allowed.
- 2.5 SLEEVE AND SLEEVE SEALS
- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.
  - 4. Pipeline Seal and Insulator, Inc.
- C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
- 1. Sealing Elements: EPDM (Ethylene-propylene-diene terpolymer rubber) or NBR (Acrylonitrile-butadiene rubber) interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Plastic or carbon steel or stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
- D. Grout: Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
- 2.6 WATERTIGHT SEALS
- A. Apply Century-Line® with Link-Seal® modular seals to seal conduits/sleeves that penetrate perimeter walls below finished grade.
- B. At wall penetration, provide watertight seal inside conduit around conductors using an industry standard expanding foam sealant. Sealant must be accessible through equipment or pull box located on interior side of wall.
- C. One year after the date of Substantial Completion, inspect and ensure seals do not leak (and have not leaked) any water inside and around conduits. Repair as needed.
- 2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING
- A. General Requirements for Handholes and Boxes:
- 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Size: minimum as required by NFPA 70 unless larger size is indicated on drawings or as indicated on plans

- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Oldcastle, Armormcast, Quazite (Hubbell), Newbasis, or approved.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering, Match system (ie electric, data, telecom, fire alarm, etc.)
  - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  - 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  - 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Above Grade Exposed Conduit: GRC or IMC.
  - 2. Concealed Conduit, Aboveground: GRC or IMC.
  - 3. Underground Conduit:
    - a. Under footprint of building: RNC, Type EPC-40-PVC, direct buried or as indicated on the drawings.
    - b. Outside of the building footprint: RNC, Type EPC-40-PVC
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 2. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Workshop
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 5. Damp or Wet Locations: IMC.
  - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size:
  - 1. Indoor areas: 1/2-inch trade size minimum
  - 2. Buried, below or in concrete slab: 3/4-inch trade size minimum
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F

### 3.2 INSTALLATION

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines. The following are exceptions for concealing conduits:
  - 1. Where specifically noted or indicated on the drawings
  - 2. Electrical rooms with surface mounted panels
  - 3. Mechanical rooms
  - 4. In open ceilings with exposed structure
  - 5. Unfinished utility corridors with exposed ceiling structure.
  - 6. In finished spaces only where specifically identified on the drawings provide surface metal raceway and surface-mount style boxes are painted to match the surrounding finishes. Coordinate work directly with contractor responsible ceiling, walls, and partition finishes.
- K. Do not install conduits exposed to solar heat gain such as roof tops unless indicated on the drawings.
- L. Support conduit within 12 inches of enclosures to which attached.
- M. Raceways Embedded in Slabs:
  - 1. Conduit embedded in concrete slabs shall be positioned within the middle third of the slab and secured with approved supports. In no case shall the outside dimension of the conduit exceed 1/3 the thickness of the slab. Conduits in slabs shall not be placed any closer than 3 conduit diameters on-center, and they shall not cross over each other.
  - 2. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in concrete.
  - 3. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 4. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 5. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 6. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- N. Stub-Ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.



- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces, or from conditioned spaces to non-conditioned spaces or to exterior structures.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

- BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
  - CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  - DD. Locate boxes so that cover or plate will not span different building finishes.
  - EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
  - FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
  - GG. Set metal floor boxes level and flush with finished floor surface.
  - HH. Existing Building Surfaces: In finished rooms where an existing wall or ceiling remains in place, cut and patch to match the surrounding finishes as required to conceal all raceways. Coordinate work directly with contractor responsible ceiling, walls, and partition finishes.
- II. Conceal raceways within existing finished ceilings, walls, and partitions, unless otherwise indicated on the drawings or as follows:
- 1. Existing Hollow Walls (such as stud walls, hollow masonry walls, or other wall types with internal voids or vertical cavities):
    - a. Outlet Boxes: If possible, use existing openings in wall, provided the opening is positioned within 24-inches of the location shown on plan for the new outlet. Otherwise, cut and patch wall as needed to install box flush.
    - b. Conduit: If possible, fish FMC (or MC cabling where permitted) down within the existing wall cavity. Otherwise, saw-cut and patch wall as needed to conceal conduit within the wall. Finish wall to match original.
    - c. This Contractor shall visit the facility to review existing conditions and determine means and methods of installation prior to bidding.
    - d. Where specifically identified on the drawings, use surface-mounted boxes and or surface-mounted conduit painted to match the surrounding finishes.
  - 2. Existing Solid Walls (filled masonry walls):
    - a. Use surface-mounted boxes and or surface-mounted conduit painted to match the surrounding finishes.
- 3.3 INSTALLATION OF CONDUIT BENEATH EXPOSED ROOF DECKING
- A. Where raceways are routed beneath roof decking that is visible from below in finished spaces, install either GRC or IMC conduit tucked-in tight within the flute of the corrugated steel decking. Avoid running conduit perpendicular to flutes by routing it across from adjacent rooms if necessary. Run conduit in a fashion that renders it as inconspicuous as possible.
  - B. Coordinate the placement of exposed conduits and junction boxes directly with the owner's jobsite representative prior to installation.
  - C. No raceways shall be routed on the topside of roof decking.
  - D. No EMT shall be routed within two inches below the underside of any roof decking.
- 3.4 INSTALLATION OF UNDERGROUND CONDUIT
- A. Direct-Buried Conduit:
    - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
    - 2. Install backfill as specified in Section 31 20 00 "Earth Moving."
    - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."

4. Install manufactured rigid steel conduit or fiberglass elbows for stub-ups at poles and equipment, horizontal directional changes and at building entrances through floor.
  - a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel or fiberglass conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment if steel conduit is used.
5. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

### 3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth. Provide 12 inches depth of crushed stone or gravel under the handhole.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. Grass area: Provide 8-inch thick by 12-inch wide concrete around handhole.

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

## SECTION 26 05 53

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- C. Delegated-Design Submittal: For arc-flash hazard study.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Comply with NFPA 70E and Section 26 05 70 "Overcurrent Protective Device Studies" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

##### 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White

3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
    - d. Neutral: Gray
  4. Color for Equipment Grounds: Green.
  5. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
- E. Equipment Identification Labels:
1. Black letters on a white field.
- 2.3 LABELS
- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches for raceway and conductors
    - b. 3-1/2 by 5 inches for equipment.
    - c. As required by authorities having jurisdiction.
- 2.4 BANDS AND TUBES
- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- 2.5 TAPES AND STENCILS
- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- B. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- C. Underground-Line Warning Tape:
1. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  2. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"

3. Tag: Type I :
    - a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    - b. Width: 3 inches.
    - c. Thickness: 4 mils.
    - d. Weight: 18.5 lb/1000 sq. ft..
    - e. Tensile according to ASTM D882: 30 lbf and 2500 psi.
  4. Tag: Type ID:
    - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    - b. Width: 3 inches.
    - c. Overall Thickness: 5 mils.
    - d. Foil Core Thickness: 0.35 mil.
    - e. Weight: 28 lb/1000 sq. ft..
    - f. Tensile according to ASTM D882: 70 lbf and 4600 psi.
- D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.
- 2.6 TAGS
- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
- 2.7 SIGNS
- A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
  2. Thickness:
    - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    - b. For signs larger than 20 sq. in., 1/8 inch thick.
    - c. Engraved legend with black letters on white face
    - d. Self-adhesive.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- 2.8 CABLE TIES
- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F.
  5. Color: Black.
- 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS
- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

#### **3.2 INSTALLATION**

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- L. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- R. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- T. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
  - 2. Use detectable Type ID underground warning tape at duct banks that have two or more conduits

3. Use Type I underground warning tape at underground branch circuits and feeders.
4. Install underground-line warning tape for direct-buried cables and cables in raceways.

U. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

V. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

W. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A: Identify with self-adhesive raceway labels or vinyl tape applied in bands.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
2. Apply the following identification colors:
  - a. 480Y/277 Volt Distribution System: Orange.
  - b. 208Y/120 Volt, Distribution System: White.
  - c. Fire Alarm System: Red.
  - d. Motor and Other Control Systems: Black.
  - e. Clock, Sound, Intercom, Data: Blue.
  - f. Ground: Green.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Marker tape or Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
3. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
4. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
5. Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around color-coding bands:
  - a. Fire Alarm System: Red.



- b. Security System: Blue and yellow.
  - c. Mechanical and Electrical Supervisory System: Brown.
  - d. Telecommunication System: Blue and yellow.
  - e. Control Wiring: Orange and red.
- I. Grounding Electrode Conductors and Grounding System Conductors: At each electrical room and communications room ground bus bar, label each raceway or conductor at the ground bus bar. Identify the destination of each grounding electrode conductor, bonding jumper and grounding system conductor. The labeling shall be by permanent adhesive label on the raceway. Conductors that terminate in the same room and the entire path is readily visible do not require labeling.
- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
- 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
    - c. Central Battery Inverter
- N. Arc Flash Warning Labeling: Self-adhesive labels.
- O. Operating Instruction Signs: Self-adhesive labels.
- P. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- Q. Equipment Identification Labels:
- 1. Indoor Equipment: Self-adhesive label.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchboards.
    - e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Emergency system boxes and enclosures.
    - g. Enclosed switches.
    - h. Enclosed circuit breakers.
    - i. Enclosed controllers.
    - j. Variable-speed controllers.
    - k. Push-button stations.
    - l. Power-transfer equipment.
    - m. Contactors.
    - n. Remote-controlled switches, dimmer modules, and control devices.
    - o. Central Battery Inverter
    - p. Monitoring and control equipment.

END OF SECTION 26 05 53

## SECTION 26 05 70

### OVERCURRENT PROTECTIVE DEVICE STUDIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes a computer-based studies and analysis as follows:
  - 1. Fault-current study to determine the minimum interrupting capacity of circuit protective devices.
  - 2. Overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  - 3. Arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.
- B. Normal distribution devices shall be coordinated to 0.2 seconds. Emergency System devices shall be selectively coordinated per NEC Article 700.32.

##### 1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. For computer software program to be used for studies.
  - 2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
    - a. Short-circuit study input data, including completed computer program input data sheets.
    - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
      - 1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
      - 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.
    - c. Coordination-study input data, including completed computer program input data sheets.
    - d. Study and equipment evaluation reports.
    - e. Arc-flash study input data, including completed computer program input data sheets.
    - f. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.

3. Overcurrent protective device coordination and arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
  - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  1. For Power System Analysis Specialist.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  2. The following are from the Short-Circuit Study Report:
    - a. Final one-line diagram.
    - b. Final Short-Circuit Study Report.
    - c. Short-circuit study data files.
    - d. Power system data.
    - e. Final protective device coordination study.
    - f. Coordination study data files.
    - g. List of all protective device settings.
    - h. Time-current coordination curves.
  3. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.

#### 1.6 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

### **PART 2 - PRODUCTS**

#### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242, IEEE 399, IEEE 551, IEEE 1584 and NFPA 70E.
- C. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of the following:
  1. Plotting and diagramming time-current-characteristic curves as part of its output.
  2. Report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  3. Arcing faults.

#### 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.

- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
  - 6. Derating factors and environmental conditions.
  - 7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
  - 1. One-line diagram of system being studied.
  - 2. Power sources available.
  - 3. Manufacturer, model, and interrupting rating of protective devices.
  - 4. Conductors.
  - 5. Transformer data.
- G. Short-Circuit Study Output Reports:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Equivalent impedance.
  - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Calculated asymmetrical fault currents:
      - 1) Based on fault-point X/R ratio.
      - 2) Based on calculated symmetrical value multiplied by 1.6.
      - 3) Based on calculated symmetrical value multiplied by 2.7.
  - 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

### 2.3 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor designations and kVA ratings.
  - 5. Switchboard, and panelboard designations.
  - 6. Any revisions to electrical equipment required by the study.
  - 7. Study Input Data: As described in "Power System Data" Article.
- D. Protective Device Coordination Study:
  - 1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
    - a. Phase and Ground Relays:
      - 1) Device tag.
      - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
      - 3) Recommendations on improved relaying systems, if applicable.
    - b. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, and ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
  - 1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
  - 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
  - 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  - 4. Plot the following listed characteristic curves, as applicable:
    - a. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    - b. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    - c. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    - d. Cables and conductors damage curves.
    - e. Ground-fault protective devices.
    - f. Motor-starting characteristics and motor damage points.
    - g. The largest feeder circuit breaker in each panelboard.
  - 5. Maintain selectivity for tripping currents caused by overloads.
  - 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
  - 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
  - 8. Comments and recommendations for system improvements.

### 2.4 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

- C. One-line diagram, showing the following:
    - 1. Protective device designations and ampere ratings.
    - 2. Conductor types, sizes, and lengths.
    - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
    - 4. Motor designations and kVA ratings.
    - 5. Switchboard, panelboard designations, and ratings.
  - D. Study Input Data: As described in "Power System Data" Article.
  - E. Arc-Flash Study Output Reports:
    - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
      - a. Voltage.
      - b. Calculated symmetrical fault-current magnitude and angle.
      - c. Fault-point X/R ratio.
      - d. No AC Decrement (NACD) ratio.
      - e. Equivalent impedance.
      - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
  - F. Incident Energy and Flash Protection Boundary Calculations:
    - 1. Arcing fault magnitude.
    - 2. Protective device clearing time.
    - 3. Duration of arc.
    - 4. Arc-flash boundary.
    - 5. Restricted approach boundary.
    - 6. Limited approach boundary.
    - 7. Working distance.
    - 8. Incident energy.
    - 9. Hazard risk category.
    - 10. Recommendations for arc-flash energy reduction.
  - G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.
- 2.5 ARC-FLASH WARNING LABELS
- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
  - B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
    - 1. Location designation.
    - 2. Nominal voltage.
    - 3. Protection boundaries.
      - a. Arc-flash boundary.
      - b. Restricted approach boundary.
      - c. Limited approach boundary.
    - 4. Arc flash PPE category.
    - 5. Required minimum arc rating of PPE in Cal/cm squared.
    - 6. Available incident energy.
    - 7. Working distance.
    - 8. Engineering report number, revision number, and issue date.
  - C. Labels shall be machine printed, with no field-applied markings.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination study only after relevant equipment submittals have been assembled.
- B. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.
- C. Provide necessary data required to complete the study to Power System Analysis Specialist.

#### **3.2 POWER SYSTEM DATA**

- A. Obtain all data necessary for conduct of the studies.
  - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
  - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  - 3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the short-circuit study, coordination study and arc-flash study. Comply with requirements in Section 01 78 39 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
  - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Obtain electrical power utility impedance at the service.
  - 3. Power sources and ties.
  - 4. Short-circuit current at each system bus (three phase and line to ground).
  - 5. Full-load current of all loads.
  - 6. Voltage level at each bus.
  - 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  - 8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  - 9. Maximum demands from service meters.
  - 10. Motor horsepower and NEMA MG 1 code letter designation.
  - 11. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  - 12. Derating factors.
  - 13. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
    - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    - d. Generator thermal-damage curve.
    - e. Ratings, types, and settings of utility company's overcurrent protective devices.
    - f. Special overcurrent protective device settings or types stipulated by utility company.
    - g. Time-current-characteristic curves of devices indicated to be coordinated.

- h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

### 3.3 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.

### 3.4 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
  - 1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
  - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
  - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.



- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
  - J. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
  - K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
    - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
  - L. Protective Device Evaluation:
    - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
    - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
    - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
    - 4. Include in the report identification of any protective device applied outside its capacity.
- 3.5 ARC-FLASH HAZARD ANALYSIS
- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
  - B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
  - C. Calculate maximum and minimum contributions of fault-current size.
    - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
    - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
    - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
    - 4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
  - D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
  - E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
  - F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
  - G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
    - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
    - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
  - H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
    - 1. When the circuit breaker is in a separate enclosure.
    - 2. When the line terminals of the circuit breaker are separate from the work location.
  - I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.6 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

3.7 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
  - 1. Low-voltage switchboard.
  - 2. Low voltage transformers.
  - 3. Panelboard and safety switch over 250 V.
  - 4. Applicable panelboard and safety switch under 250 V.
  - 5. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
  - 1. Indicate arc-flash energy.
  - 2. Indicate protection level required.

3.8 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.9 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 26 05 70

## SECTION 26 08 00

### COMMISSIONING OF ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Electrical equipment connected to Normal electrical systems, including the following:
  - a. Transformers.
  - b. Primary and secondary service electrical systems.
  - c. Distribution and branch-circuit panelboards.
  - d. Lightning protection systems.
  - e. Grounding systems.
2. Electrical equipment connected to Emergency electrical systems that provide an alternative source of power in the absence of power from the Normal electrical system, including the following:
  - a. Central Battery Inverter
3. Controls and instrumentation, including the following:
  - a. Lighting control systems.
  - b. Fire-alarm systems.
4. Systems testing and verification, including Normal and Emergency electrical systems, and transitions from Normal to Emergency electrical systems and back.

###### B. Related Requirements:

1. Section 01 91 13 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
2. Section 26 05 00 "Common Work Results for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

##### 1.2 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 01 91 13 "General Commissioning Requirements."
- B. Cx: Commissioning, as defined in Section 01 91 13 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 01 91 13 "General Commissioning Requirements."
- D. OPR: Owner's Project Requirements, as defined in Section 01 91 13 "General Commissioning Requirements."
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Construction Checklists by CxA: Draft construction checklists will be created by CxA for Contractor review.
- B. Construction Checklists by Contractor: Include the following and comply with requirements in Section 01 91 13 "General Commissioning Requirements" for construction checklists:
  1. Instrumentation and control for electrical systems.
  2. Instrumentation and control for lighting control systems.
  3. Low-voltage power cables.
  4. Control voltage power cables.
  5. Electrical feeders and branch circuits.
  6. Dry-type transformers.
  7. Instrument transformers.
  8. Low-voltage motor starters.
  9. Low-voltage air circuit breakers.
  10. Low-voltage surge protective devices.
  11. Molded-case circuit breakers.
  12. Low-voltage power circuit breakers.
  13. Grounding systems.

14. Ground-fault protection systems.
15. Panelboards.
16. Receptacles and devices.
17. Central Battery Inverter.

#### 1.4 QUALITY ASSURANCE

- A. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:
  1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
    - a. Equipment/instrument identification number.
    - b. Planned Cx application or use.
    - c. Manufacturer, make, model, and serial number.
    - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  2. Test equipment and instrumentation must meet the following criteria:
    - a. Capable of testing and measuring performance within the specified acceptance criteria.
    - b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
    - c. Be maintained in good repair and operating condition throughout duration of use on Project.
    - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- B. Proprietary Test Instrumentation and Tools:
  1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
    - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
      - 1) Instrument or tool identification number.
      - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
      - 3) Manufacturer, make, model, and serial number.
      - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
    - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
    - c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### 3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for electrical systems, subsystems, equipment, and components. Complete and submit construction checklists.

#### 3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

### 3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.
  - 1. Contributors to development of construction checklists must include, but are not limited to, the following:
    - a. Electrical systems and equipment installers.
    - b. Electrical instrumentation and controls installers.
- G. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.
- K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.
- L. Provide qualified testing and inspecting agency personnel in accordance with Section 26 00 10 "Supplemental Requirements for Electrical," instrumentation, tools, and equipment to complete and document the following:
  - 1. Performance tests.
  - 2. Demonstration of a sample of performance tests.
  - 3. Cx tests.
  - 4. Cx test demonstrations.

### 3.4 Cx TESTS FOR ELECTRICAL SYSTEMS

- A. Verification of Normal Electrical System Operation:
  - 1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal electrical system.
  - 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
  - 3. Test Purpose: Verify operation of Normal electrical system.
  - 4. Test Conditions: Energize components of Normal electrical system, one at a time.
  - 5. Acceptance Criteria: Proper operation of Normal electrical system over a 48-hour period.

- B. Verification of Essential Electrical System Operation:
  - 1. Prerequisites:
    - a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential electrical system.
    - b. Completion of "Verification of Normal Electrical System Operation" tests.
  - 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
  - 3. Test Purpose: Verify operation of Essential electrical system.
  - 4. Test Conditions:
    - a. Energize components of Normal electrical system.
    - b. Simulate a failure of Normal electrical system.
  - 5. Acceptance Criteria: Transfer of power from Normal to Essential electrical system within OPR.
- C. Verification of Control and Instrumentation:
  - 1. Prerequisites: Acceptance of results for construction checklists.
    - a. Section 26 09 23 "Lighting Control Systems and Devices."
    - b.
- D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential electrical systems.
- E. Test Conditions:
  - 1. Energize components of Normal electrical system.
  - 2. Test operation of equipment.
- F. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 26 08 00

## SECTION 26 09 23

### LIGHTING CONTROL SYSTEMS AND DEVICES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following lighting control devices:
  - 1. Timer Switch
  - 2. Standalone dimmers for LED lighting
  - 3. Standalone Phase cut dimming relay
  - 4. Lighting control system.
  - 5. Lighting control system components.
  - 6. Conductors and Cables.
- B. Related Sections include the following:
  - 1. Section 26 27 26 "Wiring Devices" for manual light switches.
  - 2. Section 26 51 00 "Lighting" for luminaire integral wireless control devices.
  - 3. Section 11 61 13 "Networked Lighting Control Systems" for theatrical control systems and devices within the Auditorium.

##### 1.2 DEFINITIONS

- A. BAS: Building Automation System.
- B. LED: Light-emitting diode.
- C. PIR: Passive infrared.
- D. Node: Digitally addressable, network device location

##### 1.3 OCCUPANCY SENSOR SYSTEM PERFORMANCE

- A. Coverage: Coverage patterns shall extend to the door of the room and provide coverage of 90% of the room minimum.
- B. Operation: Sensors shall operate as a manual on, auto off. If a sensor is dual technology, either technology can keep lights on.
- C. Time delays: Sensors shall come from factory with a 10 minute time delay. Time delay can then be adjusted in the field as necessary.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Prepared by a factory authorized representative, show installation details for lighting control relays, digital switches, and occupancy sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Schedules of all control panels
  - 3. Complete occupancy sensor layout with mounting, types, and locations indicated.
  - 4. Installation sequence and programming schedule.
- C. Order forms for all custom engraved light switches.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Record drawings reflecting as-built information, including floor plans, wiring diagrams, equipment and wiring schedules, and room schedules.
- B. Operation and Maintenance Manuals:
  - 1. Manufacturer's technical product data and maintenance data.
  - 2. Manufacturer's warranty documentation.
- C. Software and Firmware Operational Documentation:
  - 1. Software service agreement.
  - 2. Software operating and upgrade manuals.

3. Device address list.
  4. Printout of software application and graphic screens.
- D. Attic Stock: provide proof of attic stock materials delivered to the owner at Substantial Completion.
1. 4 room controllers, type L1
  2. 4 room controllers, type L2
  3. 4 occupancy sensors
- 1.6 SOFTWARE AND FIRMWARE SERVICE AGREEMENT
- A. Technical Support: Beginning at Substantial Completion provide a 5-year software service agreement to the Owner.
- B. Software and Firmware Upgrades:
1. At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from the date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
  2. Upgrade Notice: Provide a 30-day notice to Owner to allow scheduling and access to the system and to allow Owner upgrade to computer equipment if necessary.
  3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.
- 1.7 SUBSTITUTIONS
- A. Product model numbers indicated on the drawings are the basis of design and function with integral fixture control. Product substitutions of this Section affect fixture control and may result in different wiring schemes. The Contractor acknowledges that all wiring variations, equipment variations, and cost associated with the product substitution shall be borne by the Contractor and shall be at no additional cost to the Owner.
- B. Specific products listed within the specification and drawings are to be used as a standard for comparison for substitute products offered by approved manufacturers. All features and specifications of products listed are applicable to substitute products. Listing of specific products within the specification is not to be construed as approval of manufacturer for complete product line.
- 1.8 QUALITY ASSURANCE
- A. Codes and Standards:
1. NFPA 70, National Electrical Code (NEC).
  2. UL 508, Standard for Industrial Control Panels.
  3. UL 916, Standard for Energy Management Equipment.
  4. UL 917, Standard for Clock Operated Switches.
  5. UL 924, Standard for Emergency Lighting and Power Equipment.
  6. 47 CFR, Subparts A and B, for Class A digital devices.
- B. Factory Authorized Representative: A factory authorized representative shall be involved with the project for shop drawings, on-site visits for pre-wire installation, on-site inspections, on-site programming, on-site system start-up, and commissioning.
- C. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard.
- D. Comply with NEC, NEMA, and FCC emission requirements for Class A applications. Comply with applicable city, county, and state codes and ordinances.
- E. Certification: Manufacturer shall certify that products will meet product specifications and local energy codes. If any additional equipment is required to meet coverage patterns and local energy codes, provide additional equipment at no additional cost to the Owner.
- 1.9 COORDINATION
- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies. Space devices from sources of potential inference per manufactures recommendations.



1.10 WARRANTY

- A. Provide a five-year parts and one-year labor warranty on the entire control system. Warranty shall begin at the time of Project Substantial Completion.

**PART 2 - PRODUCTS**

2.1 TIMER SWITCH, DIGITAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Intermatic
  2. Leviton
  3. Paragon
  4. Tork
- B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 5-minute increments.
1. Rated 1000 W at 120 V(ac) and 277 V(ac) for LED lighting, and 1/4 hp at 120 V(ac).
  2. Standards: Comply with UL 20.
  3. Integral relay for connection to BAS.
  4. Voltage: Match the circuit voltage.

2.2 STANDALONE DIMMERS FOR LED LIGHTING (0-10V)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper.
  2. Current.
  3. Leviton.
  4. Lutron.
  5. Pass & Seymour.
- B. Basis of Design: Cooper SKYE-SF10P series or Lutron Diva (either style is acceptable).
- C. Applications: As per the drawings, single-pole (one location) or 3-way (multiple locations) wherever dimmable LED lighting fixtures are specified in rooms or spaces in which there is no requirement for a digital lighting management system or a programmable LRC.
- D. Each controller shall provide both enable-on/off and 0-10 VDC 200 mA control signal and shall be fully compatible with the LED drivers that it serves.
- E. The controller itself shall be a self-contained device rated to open and close a line-voltage branch lighting circuit or it shall consist of a local low-voltage operating device provided in conjunction with a remote line-voltage power supply/control relay rated to open and close a line-voltage branch lighting circuit.
- F. Features:
1. Classic linear-slide dimmer control, full-range, continuously variable dimming.
  2. Integral preset.
  3. ON/OFF switch that automatically returns lights to preset level.
  4. Load status LED indicator.
  5. Power-failure memory: Returns to the lighting level prior to power interruption.
  6. Integral surge protection: Meets ANSI/IEEE Standard C62.41-1980, tested to withstand momentary voltage surges up to 6000V and current surges up to 200A without damage.
  7. Electrical ratings:
    - a. 1200 W at 120 V(ac), 60 Hz.
    - b. 1660 W at 277 V(ac), 60 Hz.
    - c. For higher wattage applications, provide remote relay rated for 125% of the load.
  8. Back & side wire terminals, plus 10V wire leads.
  9. Neutral Terminal: If applicable, line-voltage devices shall be equipped with a terminal for connecting the branch circuit neutral (grounded) conductor per NEC 404.2(C), in addition to the equipment grounding conductor termination.
  10. Meets UL 94 requirements, V2 rated.
- G. Multiple dimmers located within in the same vicinity shall be mounted in a common wall-box provided with a multi-gang faceplate. Provide multiple single-gang boxes, if necessary, to maintain the wattage rating of each device, per the manufacturer's instructions.

### 2.3 STANDALONE PHASE-CUT DIMMING RELAY

- A. Phase Cut Dimming Power/ Relay Packs – 120 or 277 VAC compatible and shall have two Class 2 low-voltage cabling connectors for connecting to and from the system. Every power pack shall be configurable remotely from the software and locally via low-voltage push-button stations. Power pack shall be configurable in either occupancy or vacancy modes. Power pack mounts securely to junction box through the threaded half-inch chase nipple or can be secured to the luminaire driver channel.
1. For use converting the following dimming types:
    - a. Two-wire
    - b. Three-wire
    - c. Magnetic low voltage
    - d. Electronic low voltage

### 2.4 LIGHTING CONTROL SYSTEM

- A. Description: Fully-networked, digital lighting control system (hereafter referred to as “the system”) connected via low-voltage communications cabling:
1. The System shall have an architecture that operates with the following components:
    - a. Digital lighting control devices
    - b. Standalone lighting control zones
    - c. Network backbone for remote or time based operation.
  2. Provide system software and hardware that is warranted by a single manufacturer.
  3. Contractor is responsible to coordinate all work of this Section with all the trades covered in other Sections of the specifications to provide a complete and operable system.
- B. A networked distributed lighting control system currently exists in the existing building. Components need to be compatible with existing system and installed to tie into existing networked lighting control system. Comply with the following manufacturer:
1. Acuity Controls, Nlight
- C. Digital control devices and luminaires communicate via low-voltage cabling.
1. Control of nodes can happen at the fixture level, integral to the fixture or remotely mounted, or by zones of commonly controlled fixtures.
  2. All nodes shall communicate bidirectional via networked low-voltage cabling allowing control of relays throughout the building from common digital control switch(es).
  3. System shall be capable of interfacing with the LAN to interface with Building Management System.
  4. Isolated contacts within each relay shall provide true relay state to the electronics. True relay state shall be indicated by an on-board LED and shall be available to external control devices and systems.
  5. Operates relays on-off at programmable times, with manual switches, and with photoelectric relays.
  6. Capable of providing sequential start within groups preventing demand peaks caused by simultaneous switching.
  7. Capable of programmable manual override for after-hours occupancy with occupant warning signal.
  8. Relay quantity as indicated on schedule with indicated spare capacity.
  9. Include all accessories necessary for the system to function as indicated in the sequence of operations and lighting control schedules.
  10. System Components:
    - a. System Control Module
    - b. Wired Networked Communications Bridge
    - c. Wall Switch Sensors
    - d. Occupancy/ Vacancy Sensors
    - e. Indoor Photoelectric Sensors
    - f. Power/ Relay Packs
    - g. Auxiliary Input/ Output Devices
    - h. Wall Switches & Dimmers
- D. Computer Interface: Web or software based control system for modifying lighting control programming. Interface to include:
1. Building plans indicating zones.
  2. On/off status of all zones.
  3. Schedules to program weekend or holiday settings.
  4. Time of day control for all zones.

- E. Accessories:
  - 1. Building Automation System Interface: Provide system with optional interface to system via LON Network or BACnet IP. Interface is NIC.
  - 2. Network Card: To interface software with building network.
  - 3. Network Clock
  - 4. Provide additional modules as necessary to provide a complete system that functions as indicated on the drawings and the sequence of operations.

## 2.5 LIGHTING CONTROL SYSTEM COMPONENTS

- A. System Control Module
  - 1. Eclipse Controller, nLight model nECY or approved equal
  - 2. Shall be capable of facilitating communication and time-based control of downstream network devices and linking them to the entire system.
  - 3. Controller contains ability to reference astronomical clock for control of exterior lighting.
  - 4. Each Controller shall be capable of linking 750 devices to the network and be scalable to control up to 20,000 devices
- B. Building Network Interface
  - 1. nLight Eclipse Touchscreen, model nGWY2 GFX, or approved equal.
  - 2. Shall be capable of facilitating communication and control of downstream devices.
- C. Wired Networked Communications Bridge
  - 1. nLight model nBRG or approved equal.
  - 2. Device shall be surface-mountable to a standard 4"x4" square junction box and shall have eight Class 2 low-voltage connectors for connecting to the system. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to the System Control Module.
- D. Wall Switch Sensors – performance as described in article 2.1 above. Each switch sensor shall have two Class 2 low-voltage cabling connectors for connecting to and from the system.
  - 1. Dual-Tech: nLight model nWSXA PDT, or approved equal
  - 2. Dual-Tech with Dimming: nLight model nWSXA PDT LV DX, or approved equal
- E. Indoor Occupancy/ Vacancy Sensors – performance as described in article 2.1 above. Each sensor shall have two Class 2 low-voltage cabling connectors for connecting to and from the system.
  - 1. Dual-Tech: nLight model nCM PDT 9 or 10, or approved equal
  - 2. Dual-Tech with integrated Dimming Photocell: nLight model nCM PDT 9 or 10 ADCX, or approved equal
  - 3. Dual-Tech with High Mount Coverage: nLight model nCM PDT 6 ADCX or approved equal.
  - 4. Dual-Tech with Low Temp / High Humidity option: nLight model nCM PDT 9 or 10 LT
  - 5. Dual-Tech with integrated Dimming Photocell and Low Temp / High Humidity options: nLight model nCM 9 or 10 ADCX LT, or approved equal
- F. Indoor Photoelectric Sensors – each sensor shall have two Class 2 low-voltage cabling connectors for connecting to and from the system.
  - 1. nLight model nCMD ADCX, or approved equal
- G. Power/Relay Packs – each sensor shall have two Class 2 low-voltage cabling connectors for connecting to and from the system. Every power pack shall be configurable remotely from the software and locally via low-voltage push-button stations. Power pack mounts securely to junction box through a threaded half-inch chase nipple or can be secured to a luminaire driver channel.
  - 1. Power pack: nLight model nPP16, or approved equal
  - 2. Power pack with dimming: nLight model nPP16 D, or approved equal
  - 3. UL924 listed Power pack: nLight model nPP16 ER, or approved equal
  - 4. UL924 listed Power pack with dimming: nLight model nPP16 D ER or approved equal.
- H. Phase Cut Dimming Power/ Relay Packs – 120 or 277 VAC compatible and shall have two Class 2 low-voltage cabling connectors for connecting to and from the system. Every power pack shall be configurable remotely from the software and locally via low-voltage push-button stations. Power pack shall be configurable in either occupancy or vacancy modes. Power pack mounts securely to junction box through the threaded half-inch chase nipple or can be secured to the luminaire driver channel.
  - 1. For use converting the following dimming types:
    - a. Two-wire
    - b. Three-wire
    - c. Magnetic low voltage

d. Electronic low voltage

- I. Auxiliary Input/Output Devices – provide as required for a complete installation. Devices shall be plenum rated and be inline wired and shall have two Class 2 low-voltage cabling connectors for connecting to and from the system.
  - 1. I/O device with dimming: nLight model nIO D
  - 2. I/O device with contact closure or 0-10V dimming: nLight model nIO 1S, or approved equal
  - 3. I/O device for connection to outdoor photocell: nLight model nIO NLI, or approved equal
- J. Digital Switches – devices shall recess into a single-gang switch box and shall have two Class 2 low-voltage cabling connectors for connecting to and from the system. Multiple, adjacent switches shall be ganged together and installed with the appropriate multi-gang faceplate. Devices shall have mechanical push-buttons that provide tactile feedback and have an LED indicator light on each button and shall be custom engravable – see Low Voltage Switch Schedule on Drawing E7.2 for engraving information.
  - 1. Provide nLight model nPODMA family of low voltage switches or approved equal.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply and Load Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
- B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors sized per manufacturer's recommendations.
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors.

2.7 EQUIPMENT ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.

**PART 3 - EXECUTION**

3.1 DELEGATED DESIGN

- A. This contract shall include the complete design and application of lighting control systems. Determine all system components, cabling specifications, and programming required for complete and functional operation. If necessary, obtain clarification from Architect/Engineer prior to bidding regarding intent of contract documents.
- B. Provide additional quantities and placement of sensors as needed to achieve coverage of area served at actual mounting heights.
- C. The wiring methods indicated on the electrical drawings are to indicate design intent only. Approved manufacturer controls products may have different driver and sensor requirements and different wiring methods than what is shown on the electrical drawings. Contractors are required to familiarize themselves with all required wiring, additional parts, required installation labor, etc. to provide a complete installed system that meets the intent and functionality of the specified system.
- D. The Contractor shall provide as part of the shop drawing submittals, complete lighting drawings including all wiring, equipment, equipment locations, etc. for the submitted system.
- E. All costs shall be included in the bid for a complete operational system that meets the specified and designed system.
- F. Control Intent: Control Intent includes, but is not limited to the following:
  - 1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
  - 2. Initial sensor and switching zones.
  - 3. Initial time switch settings.

3.2 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 LIGHTING CONTROL SYSTEM INSTALLATION

- A. Install equipment in accordance with manufacturer's written installation instructions.
- B. Provide complete installation of system in accordance with Contract Documents.

- C. Install panels and connect line voltage wires from panelboard to lighting control panels and distributed relays.
- D. Connect luminaires to control network and controller interface.
- E. Connect relays and dimming control to luminaires without integral control.
- F. Install digital switches and program per lighting control switch schedule on Drawing E7.2.
- G. Connect all power supplies to spare 20A circuit in panelboard serving area.

### 3.4 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Install low voltage cables between panels and between panels and switches per manufactures written instructions.
- F. Install cabling per Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Follow "Installation of Conductors and Cables" for all low voltage control and dimming of light fixtures.
- G. For systems using unshielded twisted pair cables and crimp-on type RJ45 connectors: All cable terminations shall be performed by a BISCO certified Installer and tested using a LAN network tester.

### 3.5 SEQUENCE OF OPERATIONS

- A. See Lighting Control Sequence of Operations schedule on Drawing E7.1.
- B. Lighting controls are to utilize integral time clock and internal programming for occupied mode, unoccupied mode, and dusk to dawn operation. The lighting controls programming shall comply with 2021 International Energy Conservation Code requirements for night overrides while in unoccupied mode. Coordinate final programing and schedule with owner.
- C. Interior Lighting: Program switches to only allow lighting on for a programmable length of time during unoccupied mode. Time delay is programmable up to two (2) hours, see drawings for time delay settings for each room type.
- D. Exterior Lighting: See drawings and schedules.
- E. Interior Photoelectric Sensors: See drawings and schedules.

### 3.6 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors and lighting control panels.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label lighting control system switches with engraved and filled lettering.

### 3.7 PROGRAMMING AND DEVICE SETTINGS

- A. Manufacturer's Field Service and Commissioning: Engage a factory-authorized service representative to program, configure, test, and adjust components associated with each lighting control system and each lighting control device.
- B. Initial Programming: Upon energizing luminaires associated with lighting control stations, each control station shall be programmed to provide basic manual on/off functions (so that no luminaire remains on or off 24/7 without manual control). This initial programming shall be provided prior to the manufacturer's factory-authorized technician performing their official system programming, configuration, startup, and system commissioning services.

- C. Included in this Section is programming of the system. This start-up shall include a minimum of three (2) separate on-site visits for system verification and programming. An example outline of how this could be phased:
    - 1. Auditorium and support spaces
    - 2. Remainder of Main Building and Site
  - D. Programming of the system, per the Construction Documents, shall be performed by a factory trained manufacturer's representative.
    - 1. Programming services shall be provided at three separate times throughout the construction schedule. The installing contractor and the programmer shall prepare a plan for implementation and submit during the shop drawing submittal process. The intent is for segments of the building to be controlled as soon as practical once installed.
  - E. All lighting control equipment, devices and accessories shall be installed and operational prior to programming.
  - F. Custom engraved light switches shall be installed at all locations called out in the Construction Documents prior to programming.
  - G. BAS Controls – Coordination and Integration
    - 1. Prior to bidding, coordinate with the Division 23 temperature control contractor for wiring, integrating, and programming of building automation system (BAS) to control lighting contactors as indicated. Refer to the drawings for specific zones of control and time scheduling requirements. Coordinate final settings directly with the Owner.
- 3.8 SYSTEM STARTUP AND SYSTEM COMMISSIONING
- A. System Startup: Manufacturer's authorized technician shall confirm proper installation and operation of system components.
  - B. Provide commissioning of The System per Section 26 08 00 "Commissioning of Electrical Systems" and 2021 IECC Requirements.
- 3.9 FIELD QUALITY CONTROL
- A. Provide factory authorized representative for Initial start-up and programming of lighting control system.
  - B. Perform the following field tests and inspections and prepare test reports.
    - 1. After installing switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
    - 2. Operational Test: Verify operation of each lighting control device and adjust time delays.
  - C. Lighting control devices that fail tests and inspections are considered defective.
- 3.10 ADJUSTING
- A. Occupancy Adjustments: When requested by Owner within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose, including up to 10 hours of labor plus the necessary travel time.
    - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
    - 2. For daylight-harvesting controls, adjust set points and deadband controls to suit Owner's operations.
- 3.11 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below. Training shall not be conducted by the electrical contractor.
    - 1. Train Owner's maintenance personnel on troubleshooting, computer interface, servicing, adjusting, and preventive maintenance of all lighting control devices. Provide a minimum of four (4) hours training. Provide a USB flash drive, or other acceptable digital video format, of the video-recorded training session to the owner.
    - 2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
    - 3. Schedule training with Owner, through Architect-Engineer, with at least seven (7) days' advance notice.

4. Six months after completion of project, factory-authorized representative shall provide one 2-hour owner re-training session.

END OF SECTION 26 09 23

## SECTION 26 22 13

### LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 3. Include diagrams for power, signal, and control wiring.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB (Electrification Products Division).
  - 2. Acme Electric Corporation.
  - 3. Eaton.
  - 4. Schneider Electric USA (Square D).
  - 5. Siemens Industry, Inc., Energy Management Division.
  - 6. Sola/Hevi-Duty; Emerson Electric Co
- B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

##### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.



- C. Transformers Rated 15 kVA and Larger:
  - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  - 1. One leg per phase.
  - 2. Grounded to enclosure.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Coil Material: Copper.
  - 2. Internal Coil Connections: Brazed or pressure type.
  - 3. Terminal Connections: Welded.
- D. Enclosure: Ventilated.
  - 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
  - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
  - 4. Finish: Comply with NEMA 250.
- E. Taps for Transformers 3 kVA and Smaller: None.
- F. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- I. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 80 deg C rise above 40 deg C ambient temperature.
- J. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- K. K-factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor
  - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor without exceeding the indicated insulation class in a 40 deg C maximum ambient and a 24-hour average ambient of 30 deg C.
  - 2. Indicate value of K-factor on transformer nameplate.
  - 3. Unit shall comply with requirements of DOE 2016 efficiency levels when tested according to NEMA TP 2 with a K-factor equal to one.
- L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  - 2. Include special terminal for grounding the shield.
- M. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.
- N. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
  - 1. 9.00 kVA and Less: 40dBA.
  - 2. 9.01 to 30.00 kVA: 45dBA.
  - 3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9, 48 dBA for K-factors of 13 and 20.
  - 4. 50.01 to 150.00 kVA: 50 dBA for K-factors of 1, 4, and 9, 53 dBA for K-factors of 13 and 20.
  - 5. 150.01 to 300.00 kVA: 55 dBA for K-factors of 1, 4, and 9, 58 dBA for K-factors of 13 and 20.

### 2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  - 2. Ratio tests at rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at rated voltage connections.
  - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
  - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  - 6. Applied and induced tensile tests.
  - 7. Regulation and efficiency at rated load and voltage.
  - 8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  - 9. Temperature tests.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- B. Construct concrete bases according to Section 03 30 00 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- C. Secure transformer to concrete base according to manufacturer's written instructions.
- D. Install transformers on isolation waffle pads where indicated on drawings.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.

- B. Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 13

## SECTION 26 24 13

### SWITCHBOARDS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Service and distribution switchboards rated 600 V and less.
  - 2. Surge protection devices.
  - 3. Disconnecting and overcurrent protective devices.
  - 4. Instrumentation.
  - 5. Identification.
- B. Related Requirements
  - 1. Section 26 05 70 "Overcurrent Protective Device Studies" for selecting overcurrent devices, adjustment of breakers, and arc flash analysis requirements.

##### 1.2 ACTION SUBMITTALS

- A. Submit written Short Circuit and Coordination Studies, Arc-Flash Hazard Analysis and reports, as required by Section 26 05 70 concurrently or prior to submittals required by this section.
- B. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
  - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- C. Shop Drawings: For each switchboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
  - 5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
  - 6. Detail utility company's metering provisions with indication of approval by utility company.
  - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
  - 9. Include schematic and wiring diagrams for power, signal, and control wiring.
- D. Delegated Design Submittals:
  - 1. For arc-flash hazard analysis.
  - 2. For arc-flash labels.
  - 3. For Short Circuit Studies
  - 4. For Coordination Studies

##### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for switchboards and all installed components.
    - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
    - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.6 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
  - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 104 deg F.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.

1.7 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB (Electrification Products Division).
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
  - 4. Siemens Industry, Inc., Energy Management Division.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
  - D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - E. Comply with NEMA PB 2.
  - F. Comply with NFPA 70.
  - G. Comply with UL 891.
  - H. Front-Connected, Front-Accessible Switchboards:
    - 1. Main Devices: Fixed, individually mounted.
    - 2. Branch Devices: Panel mounted.
    - 3. Sections front and rear aligned.
  - I. Nominal System Voltage: As indicated on one-line diagram
  - J. Main-Bus Continuous: As indicated on one-line diagram
  - K. Indoor Enclosures: Steel, NEMA 250, Type 1.
  - L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
  - M. Barriers: Between adjacent switchboard sections.
  - N. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.
  - O. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
  - P. Buses and Connections: Three phase, four wire unless otherwise indicated.
    - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
    - 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity,.
    - 3. Copper feeder circuit-breaker line connections.
    - 4. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
    - 5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions on one end.
    - 6. Disconnect Links:
      - a. Isolate neutral bus from incoming neutral conductors.
      - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
    - 7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  - Q. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
- 2.2 SURGE PROTECTION DEVICES
- A. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
  - B. Features and Accessories:
    - 1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
    - 2. Indicator light display for protection status.
    - 3. Form-C contacts rated at 2 A and 24-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    - 4. Surge counter.

- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 300 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
  - 2. Line to Ground: 1200 V for 480Y/277 V and 1200 V for 208Y/120 V.
  - 3. Line to Line: 2000 V for 480Y/277 V and 1000 V for 208Y/120 V.
- E. SCCR: Equal or exceed 200 kA.
- F. Nominal RATING: 20 kA.

### 2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Provide Arc Energy Reducing Maintenance Switch on any breaker or fusible disconnect switch which can be adjusted 1,200 A or higher per NEC 240.67 and 240.87.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Circuit breaker types, frame sizes, and functionality shall be as required to meet the overcurrent device selectivity requirements as noted in 26 05 70 Overcurrent Protective Device Study, but as a minimum shall be:
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long and short time adjustments.
    - d. Ground-fault pickup level, time delay, and I squared t response.
  - 3. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- C. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
  - 1. Fixed circuit-breaker mounting.
  - 2. Two-step, stored-energy closing.
  - 3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Time adjustments for long- and short-time pickup.
    - c. Ground-fault pickup level, time delay, and I squared t response.

### 2.4 INSTRUMENTATION

- A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
  - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    - d. Megawatts: Plus or minus 1 percent.
    - e. Megavars: Plus or minus 1 percent.
    - f. Power Factor: Plus or minus 1 percent.
    - g. Frequency: Plus or minus 0.1 percent.
    - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.

- i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

## 2.5 IDENTIFICATION

- A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.
  1. Nameplate: At least 0.032-inch- thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.
- B. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
  1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
  2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
  3. Protect from moisture, dust, dirt, and debris during storage and installation.
  4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
  1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to switchboards.
  6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, surge protection devices, and instrumentation.
  1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Comply with NECA 1.



### 3.3 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections:
  - 1. Acceptance Testing:
    - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    - b. Test continuity of each circuit.
  - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 70 "Overcurrent Protective Device Studies."

### 3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 26 24 13

## SECTION 26 24 16

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

##### 1.2 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

##### 1.3 ACTION SUBMITTALS

- A. Submit written Short Circuit and Coordination Studies, Arc-Flash Hazard Analysis and reports, as required by Section 26 05 70 concurrently or prior to submittals required by this section.
- B. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
  - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 4. Detail bus configuration, current, and voltage ratings.
  - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 6. Include evidence of NRTL listing for series rating of installed devices.
  - 7. Include evidence of NRTL listing for SPD as installed in panelboard.
  - 8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 9. Include wiring diagrams for power, signal, and control wiring.
  - 10. Key interlock scheme drawing and sequence of operations.
  - 11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 FIELD CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Owner's written permission.
  - 3. Comply with NFPA 70E.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB (Electrification Products Division).
  - 2. Eaton.
  - 3. Schneider Electric USA (Square D).
  - 4. Siemens Industry, Inc., Energy Management Division
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Height: 84 inches maximum.
  - 3. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
- G. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- H. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch circuit equipment grounding conductors; bonded to box.
  - 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  - 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
  - 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  - 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  - 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- J. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  - 1. Future spaces: number as indicated in panelboard schedules on the drawings.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
  - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

- M. Provide factory installed integral SPDs in Panelboards which serve emergency systems (NEC 700), and as indicated on the drawings.
- 2.2 PERFORMANCE REQUIREMENTS
- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.
- 2.3 POWER PANELBOARDS
- A. Panelboards: NEMA PB 1, distribution type.
  - B. Mains: as indicated on plans.
  - C. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
  - D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
  - B. Mains: as indicated on plans.
  - C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
  - D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES
- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents. Circuit breaker types, frame sizes, and functionality shall be as required to meet the overcurrent device selectivity requirements as noted in 26 05 70 Overcurrent Protective Device Study, but not less than as noted below:
    - 1. Thermal-Magnetic Circuit Breakers:
      - a. Inverse time-current element for low-level overloads.
      - b. Instantaneous magnetic trip element for short circuits.
      - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    - 2. Electronic Trip Circuit Breakers:
      - a. RMS sensing.
      - b. Field-replaceable rating plug or electronic trip.
      - c. Digital display of settings, trip targets, and indicated metering displays.
      - d. Multi-button keypad to access programmable functions and monitored data.
      - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
      - f. Integral test jack for connection to portable test set or laptop computer.
      - g. Field-Adjustable Settings:
        - 1) Instantaneous trip.
        - 2) Long- and short-time pickup levels.
        - 3) Long and short time adjustments.
        - 4) Ground-fault pickup level, time delay, and I squared T response.
    - 3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
    - 4. Subfeed Circuit Breakers: Vertically mounted.
    - 5. MCCB Features and Accessories:
      - a. Standard frame sizes, trip ratings, and number of poles.
      - b. Breaker handle indicates tripped status.
      - c. UL listed for reverse connection without restrictive line or load ratings.
      - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
      - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
      - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

- g. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
- h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
- i. Multipole units enclosed in a single housing with a single handle.
- j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory inside panelboard door mounted in metal frame with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
  - 1. Install floor panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 1-1/4 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 70 "Overcurrent Protective Device Studies."

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Tamper-Resistant receptacles, 125 V, 20 A.
  - 2. GFCI receptacles, 125 V, 20 A.
  - 3. USB receptacles, 125 V, 20A
  - 4. Twist-locking receptacles.
  - 5. Cord Reel
  - 6. Toggle switches, 120/277 V, 20 A.
  - 7. Wall plates.

##### 1.2 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing. Wiring Devices in Auditorium: Black
  - 2. Isolated-Ground Receptacles: Orange.



- H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
  - I. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
    - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
    - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
    - 3. Leviton Mfg. Company Inc. (Leviton).
    - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
- 2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A
- A. Isolated-Ground Duplex Receptacles, 125 V, 20 A
    - 1. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
    - 2. Configuration: NEMA WD 6, Configuration 5-20R.
    - 3. Standards: Comply with UL 498 and FS W-C-596.
  - B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A
    - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
    - 2. Configuration: NEMA WD 6, Configuration 5-20R.
    - 3. Standards: Comply with UL 498 and FS W-C-596.
    - 4. Products: Subject to compliance with the requirement, provide one of the following:
      - a. Cooper TRBR20
      - b. Hubbell BR20TR
      - c. Leviton TBR20
      - d. Legrand/P&S TR5362
    - 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- 2.3 GFCI RECEPTACLES, 125 V, 20 A
- A. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20:
    - 1. Provide tamper resistant versions of the straight blade receptacles series specified above.
    - 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
    - 3. Configuration: NEMA WD 6, Configuration 5-20R.
    - 4. Type: Feed through.
    - 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
    - 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- 2.4 USB RECEPTACLES
- A. Tamper-Resistant Duplex and USB Charging Receptacles:
    - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
    - 2. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
    - 3. USB Receptacles: (1) USB Type A and (1) USB Type C; 5 V dc, and 2.1 A per receptacle (minimum).
    - 4. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
    - 5. Products: Subject to compliance with the requirements, basis-of-design:
      - a. Leviton T5832
    - 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- 2.5 TWIST-LOCKING RECEPTACLES
- A. Twist-Lock, Single Receptacles: 120 V, 250 V, or 277V; 20-60 A:
    - 1. Configuration: NEMA WD 6, Configuration as noted on Drawings
    - 2. Standards: Comply with UL 498.

## 2.6 CORD REELS

- A. Description: Industrial grade, retracting cord reel. 25-foot cord minimum SJO cord, 12 AWG, 3 conductor (ground). White cord reel housing. Duplex GFCI type receptacle in yellow aluminum outlet box.
  - 1. Hubbell HBLI25123GF20
- B. Manufacturers: Basis of Design is Hubbell. Acceptable manufacturer is Daniel Woodhead.
- C. 5-foot power supply cord and NEMA 5-15P plug, Hubbell #HBL5366C.
- D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector . Kellems grip for strain relief, Hubbell #07401135.
- E. Adjustable stop.
- F. Standards: Comply with FS W-C-596.

## 2.7 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper: CSB120
    - b. Hubbell: CSB120
    - c. Leviton: 1221-2
    - d. Pass & Seymour: CSB20AC1
  - 2. Standards: Comply with UL 20 and FS W-S-896.
- B. Three-Way Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper: CSB320
    - b. Hubbell: CSB320
    - c. Leviton: 1223-2
    - d. Pass & Seymour: CSB20AC3
  - 2. Comply with UL 20 and FS W-S-896.

## 2.8 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished and Unfinished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
  - 3. Material for Finished Auditorium Spaces: Smooth, high impact thermoplastic.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable in-use cover. Extra large covers are not acceptable.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
  - D. Device Installation:
    1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
    2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
    3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
    4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
    5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
    6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
    7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
    8. Tighten unused terminal screws on the device.
    9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
  - E. Receptacle Orientation:
    1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
      - a. In existing buildings, match the configuration of existing devices.
  - F. Tamper Resistant Receptacles: Provide as required by the current adopted NEC 406.12. regardless of how receptacles are indicated on the drawings.
  - G. Wet locations: Provide weatherproof cover plates at exterior and interior wet locations as required by the current adopted NEC whether indicated as such on the drawings or not, in addition to those devices that are specifically denoted on the drawings with a "R" or "WP" to receive weatherproof covers
  - H. Maintenance Receptacles for HVAC equipment: whether denoted on the drawing or not, provide accessible 125V, 20A, duplex GFCI receptacle located within 25 feet of HVAC equipment per current adopted NEC. Connect to 20 amp general purpose circuit
  - I. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
  - J. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.
- 3.2 GFCI RECEPTACLES
- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.
  - B. Provide GFCI receptacles or GFCI breaker as required by NEC 210.8 at the following locations whether denoted on the drawings or not:
    1. Within 6-feet of the outside edge of a sink or other "wet location" applications unless exception is applicable by the most current adopted NEC.
    2. Restrooms, locker rooms, and bathing/showering areas
    3. food service preparation areas and/or kitchen areas
    4. Laundry areas
    5. Outdoors, including mechanical rooftop units unless exception is applicable by the most current adopted NEC.
    6. Garages and maintenance areas where electrical portable tools are used.
    7. Electric water coolers
    8. Vending machines
    9. Other locations as required by the current adopted edition of the NEC
- 3.3 IDENTIFICATION
- A. Comply with Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 3. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 4. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 26 27 26

## SECTION 26 28 13

### FUSES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Cartridge fuses rated 600 V ac and less for use in the following:
    - a. Control circuits.
    - b. Enclosed controllers.
    - c. Enclosed switches.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  3. Current-limitation curves for fuses with current-limiting characteristics.
  4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
  5. Fuse sizes for elevator feeders and elevator disconnect switches.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 77 00 "Closeout Procedures," include the following:
1. Ambient temperature adjustment information.
  2. Current-limitation curves for fuses with current-limiting characteristics.
  3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project.
  4. Coordination charts and tables and related data.

##### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

##### 1.5 FIELD CONDITIONS

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann by Eaton
  2. Littelfuse
  3. Mersen
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  - 2. Type CC: 600-V, zero- to 30-A rating, 200 Kaic, time delay.
  - 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

**PART 3 - EXECUTION**

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Motor Branch Circuits: Class RK1, time delay.
  - 2. Large Motor Branch (601-4000 A): Class L, time delay.
  - 3. Power Electronics Circuits: Class J, high speed.
  - 4. Other Branch Circuits: Class J, time delay.
  - 5. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  - 6. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

**SECTION 26 28 16**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Motor-rated toggle switches.
  - 4. Elevator Disconnect
  - 5. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed disconnect switch, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed disconnect switches to include in emergency, operation, and maintenance manuals.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Warranty documents.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Greater than one (1) year from date of Substantial Completion.
    - a. If the manufacturer's warranty commences upon the date materials are delivered, then the manufacturer's warranty period must be at least two (2) years to meet the requirement stated above.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Source Limitations: Obtain enclosed disconnect switches, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed disconnect switches, including clearances between enclosures, and adjacent surfaces and other items. Comply with maximum dimensions, if indicated, and required workspace clearances and actual space available at mounting location.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### **2.2 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
  - 1. ABB (Electrification Products Division).
  - 2. Eaton Electrical Inc.
  - 3. Schneider Electric USA (Square D).
  - 4. Siemens Industry, Inc., Energy Management Division.

### **2.3 FUSIBLE SWITCHES**

- A. Type HD, Heavy Duty:
  - 1. Single Throw: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.
- B. Voltage Rating, Ampere Rating, and Quantity of Poles: Refer to the Drawings.
- C. Fuse Type, Rating, and Quantities: Refer to the Drawings.
- D. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors. Provide for each application in which the feeder contains a grounded conductor (neutral wire).
  - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

### **2.4 NONFUSIBLE SWITCHES**

- A. Type HD, Heavy Duty:
  - 1. Single Throw: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks and interlocked with cover in closed position.
- B. Voltage Rating, Ampere Rating, and Quantity of Poles: Refer to the Drawings.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors. Provide for each application in which the feeder contains a grounded conductor (neutral wire).
  - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

### **2.5 MOTOR-RATED TOGGLE SWITCHES**

- A. Motor-Starting Switches (without motor overload protection): "Quick-make, quick-break" heavy-duty toggle; non-fusible.
  - 1. Lockable in the off position.
  - 2. Factory markings indicating whether unit is off or on.
  - 3. Ratings: 600-V ac, 30-A.
  - 4. Quantity of Poles: As required or as indicated on the Drawings.
  - 5. Surface-mounted in unfinished spaces.
  - 6. Flush-mounted with stainless steel faceplate in finished spaces.



7. Red Pilot light: To be included if indicated on the Drawings.

## 2.6 ELEVATOR DISCONNECT

- A. Manufacturers:
  1. ABB (Electrification Products Division).
  2. Eaton Electrical Inc. (Bussman)
  3. Schneider Electric USA (Square D).
  4. Siemens Industry, Inc., Energy Management Division.
- B. Elevator Control Switch: Provide Elevator Control Switch in a single NEMA enclosure with all necessary relay(s), control transformer, and other options (as listed below), and as shown on drawings. The Elevator Control Switch shall have an ampere rating as shown on the Contract Drawings and shall include a horsepower rated fusible switch with shunt trip capabilities. The amp rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J Fuses (provided separately).
  1. It shall include as an accessory, a 100VA control power transformer with primary and secondary fuses. The primary voltage rating shall be 480 VAC with a 120 VAC secondary.
  2. It shall contain an isolation relay (3PDT, 10 amps, 120V). The coil of the isolation relay shall be 120 VAC.
  3. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V).
  4. The module shall contain the following options?
    - a. Key to Test Switch
    - b. "ON" Pilot Light (Green, Red, or White)
    - c. Isolated Full Capacity Neutral Lug
    - d. 1P NC Mechanically Interlocked Auxiliary Contact
    - e. Fire Alarm Voltage Monitoring Relay as required to comply with NFPA 72
    - f. NEMA 1 Enclosure (optional 12, 3R, or 4)

## 2.7 ENCLOSURES

- A. UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Environmental Rating Applications:
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R, galvanized steel.
  3. Indoor Wet or Damp Locations: NEMA 250, Type 4, stainless steel.
- C. Enclosure Finish:
  1. Type 1, Steel: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel.
  2. Types 1, 3R, 12, Galvanized Steel: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel.
  3. Type 1, 4-4X, Stainless Steel: A brush finish on Type 304 stainless steel.
- D. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both end-walls.
- E. Operating Mechanism:
  1. NEMA 250 Type 1: The operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover.
  2. NEMA 250 Type 3R: The operating handle shall be directly operable through the dead front trim of the enclosure.
  3. NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the disconnect is in the closed position (ON) and to prevent closing the circuit (ON) when the enclosure cover is open.
  4. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed disconnect switches for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

#### **3.2 INSTALLATION**

- A. Coordinate layout and installation of disconnect switches, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted disconnect switches with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

#### **3.3 IDENTIFICATION**

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

#### **3.4 FIELD QUALITY CONTROL**

- A. Perform Tests and Inspections:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with the manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of the manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - i. Verify correct phase barrier installation.
    - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
  - 2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
    - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
    - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
  - B. Disconnect switches will be considered defective if they do not pass tests and inspections.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by the manufacturer.

END OF SECTION 26 28 16

**SECTION 26 28 17**

**COMPANY SWITCHES**

**PART 1 - GENERAL**

**1.1 ACTION SUBMITTALS**

- A. Submittal shall include data sheet identifying the following:
  - 1. Circuit breaker type and overcurrent protection rating
  - 2. SCCR rating
  - 3. Line connection lug sizes
  - 4. Load connection type, quantity and size
  - 5. Enclosure construction and dimensions
  - 6. Listings and compliance data
  - 7. Mounting and installation details
- B. Manufacturer shall furnish with the submittal and with each unit delivered an equipment manual that details the installation, operation and maintenance instructions for the specified unit.

**1.2 CLOSEOUT SUBMITTALS**

- A. Provide warranty information
- B. Provide test reports.

**1.3 LABELING**

- A. Switches shall be provided with permanently attached circuit identification labels as show on drawings.
- B. Note: coordinate specific labeling with QT specialist or Owner as applicable.

**1.4 FACTORY TESTING**

- A. All equipment shall be thoroughly tested in Manufacturer's shop prior to shipment to insure mechanical and electrical integrity.
- B. Equipment shall be subjected to a factory dielectric strength (hipot) test in accordance with IEEE 4 or IEC 60950 to verify integrity of insulation and proper conductor clearances.

**1.5 WARRANTY**

- A. Contractor shall assure that this equipment is provided free of defects in materials and workmanship and shall provide a warranty under this contract for a period of one (1) year from the date of final acceptance by the Owner.
- B. During the warranty period, repair or replacement of defective materials and/or repair of faulty workmanship shall be provided, at no cost to the Owner, within ten (10) days of written notice of the defect(s).

**1.6 QUALITY ASSURANCE**

- A. Switch manufacturer shall have been continuously engaged in the production of theatrical wiring devices for at least ten (10) years.
- B. Comply with NFPA 70.
- C. Comply with NECA's "Standard of Installation."

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Electronic Theatre Controls (ETC)
    - a. Address: 3031 Pleasant View Road, Middleton, WI 53562
    - b. Contact: Sylvia Sinclair (midwest)
    - c. Email: sylvia.sinclair@etcconnect.com
    - d. Contact: Joe DiNardo (east)
    - e. Email: joe.dinardo@etcconnect.com
    - f. Contact: Rob Raff (southeast)
    - g. Email: rob.raff@etcconnect.com
    - h. Contact: Nick Wurzel (southwest)
    - i. Email: nick.wurzel@etcconnect.com j. Phone: (800) 688-4116
  - 2. ESL Power Systems, Inc.
    - a. Address: 2800 Palisades Drive, Corona, CA 92880
    - b. Contact: John Chaney
    - c. Email: jchaney@eslpwr.com d. Phone: (800) 922-4188
  - 3. SSRC
    - a. Address: 170 Fortis Drive, Duncan, SC 29334
    - b. Contact: Aaron Clark
    - c. Email: aclark@ssrconline.com d. Phone: (864) 848-9770
  - 4. Stagecraft Industries, Inc.
    - a. Address: 5051 North Lagoon Avenue, Portland, Oregon 97217
    - b. Contact: Ted Ross
    - c. Email: tedr@stagecraftindustries.com d. Phone: (503) 286-1600
  - 5. Union Connector
    - a. Address: 40 Dale Street, West Babylon, NY 11704
    - b. Contact: Ray Wolpert
    - c. Email: rayw@unionconnector.com d. Phone: (631) 753-9550

**2.2 CONSTRUCTION:**

- A. Enclosure:
  - 1. NEMA Type 1 dead-front panelboard enclosure, unless otherwise specified or required to meet environmental conditions of installed location. Enclosure shall be UL listed as Service Entrance Equipment, and shall be identified as such with permanent labeling.
  - 2. Enclosure shall consist of powder-coated finish, minimum 14 gauge steel, with following maximum dimensions:
  - 3. ETC and SSRC switches are larger than others. For space restricted projects, consider smaller maxima listed to side for all non-ETC/SSRC devices:

Amps	Height	Width	Depth
60-100A	46" [37"]	21"	10"
200-400A	72" [45"]	29" [24"]	12" [10"]
600A	48"	24"	12"
800A	48"	24"	12"

- 4. Enclosure shall contain minimum (4) mounting tabs for surface mounting.
- 5. Enclosure shall contain hinged door to provide access to load bus lugs within the connection chamber. Door shall be secured with panel latches that can be padlocked. Opening of this door shall result in shunt-trip of the circuit breaker.
- 6. Bottom of enclosure shall contain hinged flap or grommated slot for load cable access. For exterior applications with NEMA 3R enclosures, this access shall be protected with rubber sweeps.
- 7. Top panel shall be blank to permit Contractor connection of line service conduit or wireway.

B. Electrical:

1. Main circuit breaker shall be UL listed molded case type, rated for 100% current load as scheduled on drawings, and shall have a shunt-trip mechanism with micro-switch at connection chamber access door. Breaker shall have a current interrupt rating of 65,000 AIC at 240 volts.
2. Circuit breaker or actuator handle shall be prominently accessible on the enclosure front panel. A locking bar or tabs shall be installed to permit padlock lockout of the circuit breaker in the 'Off' position.
3. Line service connection shall be to lugs on bus/breaker, sized for copper conductors as follows:

Amps	Phase	Neutral	Ground
60-100	#14-4/0	#4-2/0	#8-1/0
200	#1/0-300KCM	#1/0-300KCM	#4-2/0
400	(2) 250KCM	(2) 300KCM	#4-2/0
	400KCM	#2/0-600KCM	
600	(2) 400KCM	(2) 400KCM	#6-250KCM
	(2) 500KCM	(2) 500KCM	

4. Ground lug shall be bonded to enclosure.
5. Indicator lights shall be provided to indicate load voltage presence on each phase.
6. Cam-Style Load Connections, for company switches through 400A rating:
  - a. Company Switch shall be equipped with six (6) single pole cam-style quarter turn locking connectors mounted to bottom of panel, color coded to match phase/neutral/ground conductors. Arrange connectors as follows:

	Phase 1 (Black)	Phase 2 (Red)	Phase 3 (Blue)		Neutral (White)	Neutral (White)	Ground (Green)

Row 1 type:	Female	Female	Female	Female	Female	Female
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- b. Each connector shall be rated for 400 amps at 600 volts continuous duty, and shall be listed to UL 1691. Approved manufacturer and series shall include:
    - 1) Cooper Interconnect Cam-Lok E1016 series
    - 2) Leviton Cam-Type 16 series
    - 3) Hubbell Kellums HBLFR series
  - c. Each connector shall have a spring-action protective snap cover to protect conductor from contact or debris when not in use.
  - d. Comply with NEC 300.20 as applicable where connector bodies penetrate panel enclosure. Comply with NEC 520.53 labeling requirement for sequential connect/disconnect of single pole feeder cabling.
7. Bare Wire Load Connections:
  - a. The bus bar for each phase, neutral, and ground shall be equipped with dual screw-style lugs to permit termination of bare copper feeder conductors sized from #4 to 4/0 per lug. All lugs shall accept one hex key size for tightening/loosening of lug screws.
    - 1) Exception: Switches rated at 60-100A may be equipped with single lugs per bus bar, sized for #4 to 2/0 per lug.
  - b. Provide internal strain relief bar to prevent tensioning on cable terminations. Provide 5/16"-18 minimum eyebolt secured to enclosure bottom panel (or to adjacent structure beneath panel), for tie-off of feeder cabling below enclosure. Furnish 60" length of braided nylon or poly rope, choked to eyebolt.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches.
- B. Mount individual wall-mounted switches with tops at uniform height, unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install switches level and plumb, in locations as indicated, according to manufacturer's written instructions.
- E. Connect switches and components to wiring system and to ground as indicated and in accordance with manufacturer instructions.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- G. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

#### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Section 26 05 53 "Identification for Electrical Systems."

#### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Prepare for acceptance testing as follows:
  - 1. Inspect mechanical and electrical connections.
  - 2. Verify switch and relay type and labeling verification.
  - 3. Verify rating of installed fuses.
  - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
  - 2. Perform megohmmeter testing of feeder cabling.
  - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 28 17



## SECTION 26 29 13

### FULL VOLTAGE MOTOR CONTROLLERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Manual motor controllers.
  - 2. Enclosed full-voltage magnetic motor controllers.
  - 3. Combination full-voltage magnetic motor controllers.
  - 4. Enclosures.
  - 5. Accessories.
  - 6. Identification.

##### 1.2 DEFINITIONS

- A. BAS: Building Automation System
- B. CPT: Control power transformer.
- C. NC: Normally closed.
- D. OCPD: Overcurrent protective device.
- E. SCCR: Short-circuit current rating.
- F. SCPD: Short-circuit protective device.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for magnetic controllers and installed components.
    - b. Manufacturer's written instructions for setting field-adjustable overload relays.
    - c. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
    - d. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

##### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.

2. Altitude: Not exceeding 6600 feet.

#### 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Greater than one (1) year from date of Substantial Completion.
    - a. If the manufacturer's warranty commences upon the date materials are delivered, then the manufacturer's warranty period must be at least two (2) years to meet the requirement stated above.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

#### 2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed disconnect switches, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed disconnect switches, including clearances between enclosures, and adjacent surfaces and other items. Comply with maximum dimensions, if indicated, and required workspace clearances and actual space available at mounting location.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

#### 2.3 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.

#### 2.4 MANUAL MOTOR CONTROLLERS

- A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  1. Standard: Comply with NEMA ICS 2, general purpose, Class A.
  2. Configuration: Non-reversing.
  3. Flush or surface mounting as indicated on the Drawings.
  4. Green pilot light.
- B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  1. Configuration: Non-reversing.
  2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  3. Green pilot light.
- C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
  1. Configuration: Non-reversing.
  2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

2.5 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.
- B. Standard: Comply with NEMA ICS 2, general purpose, Class A.
  - 1. Configuration: Non-reversing.
- C. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
  - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- D. Overload Relays:
  - 1. Thermal Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - d. Ambient compensated.
    - e. Automatic resetting.
  - 2. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - d. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

2.6 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the enclosed controller described in this article (above), plus indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Fusible Disconnecting Means:
  - 1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
  - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - 3. Voltage Rating, Ampere Rating, and Quantity of Poles: Refer to the Drawings.
  - 4. Fuse Type, Rating, and Quantities: Refer to the Drawings.
- C. Nonfusible Disconnecting Means:
  - 1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
  - 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - 3. Voltage Rating, Ampere Rating, and Quantity of Poles: Refer to the Drawings.

2.7 ENCLOSURES

- A. UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6
- C. Enclosure Environmental Rating Applications:
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R, galvanized steel.
- D. Enclosure Finish:
  - 1. Type 1, Steel: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel.
  - 2. Types 1, 3R, 12, Galvanized Steel: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel.
- E. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both end-walls.
- F. Operating Mechanism:
  - 1. NEMA 250 Type 1: The operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover.

2. NEMA 250 Type 3R: The operating handle shall be directly operable through the dead front trim of the enclosure.
3. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

## 2.8 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Standard duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
    - a. Hand-Off-Auto Selector Switches: Default accessory, unless otherwise indicated on the Drawings.
    - b. Push Buttons: As indicated on the Drawings.
    - c. Pilot Lights: As indicated on the Drawings.
  2. Lugs: Mechanical type, suitable for number, size, and conductor material.
  3. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
- B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.
  1. Phase-failure.
  2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
  3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.
- C. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

## 2.9 IDENTIFICATION

- A. Controller Nameplates: As described in Section 26 05 53 "Identification for Electrical Systems," fastened with corrosion-resistant screws or adhesive.
- B. Arc-Flash Warning Labels: As described in Section 26 05 70 "Overcurrent Protective Device Studies".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.
- F. Where applicable, coordinate control wiring connections with contractor providing BAS controls.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform Tests and Inspections:
  - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify the unit is clean.
    - e. Inspect contactors:
      - 1) Verify mechanical operation.
      - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
    - f. Motor-Running Protection:
      - 1) Verify overload element rating is correct for its application.
      - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
  - 3. Electrical Tests:
    - a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
    - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
    - c. Test motor protection devices according to manufacturer's published data.
    - d. Perform operational tests by initiating control devices.
- B. Motor controller will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
  - 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
  - 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
  - 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 26 29 13

## SECTION 26 33 23

### CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interruptible, fast transfer, central battery equipment.
  - 2. Enclosures.
  - 3. Optional and accessory features.
- B. General Description of Central Battery Equipment for Emergency Lighting:
  - 1. Each unit serves primarily as an emergency standby lighting power supply configured as a line-interactive system normally "off-line", as opposed to a continuous on-line system, with a fully active inverter only in emergency mode to maximize energy efficiency under normal power. Each unit shall be entirely self-contained within an enclosure, including sealed maintenance-free batteries, AC to DC rectifier, battery charger, DC to AC inverter, transistorized static transfer switch, solid-state double conversion digital signal processing and a high frequency pulse-width modulated (PWM) design harnessing the advantages of IGBTs (Insulated-Gate Bipolar Transistors). System shall provide high quality regulated and conditioned AC power to all types of lighting loads, including sensitive electronic LED lighting.

##### 1.2 DEFINITIONS

- A. DDC: Direct digital control.
- B. IBC: International Building Code.
- C. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time shall be "fast" (2-4 ms).
- D. LED: Light-emitting diode.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- F. NiCd: Nickel cadmium.
- G. OCPD: Overcurrent protective device.
- H. PC: Personal computer.
- I. PWM: Pulse-width modulated.
- J. TDD: Total demand (harmonic current) distortion (also listed as "THD" in catalog data by manufacturers).
- K. Uninterruptible: As used in the Section Text, an on-line, double-conversion (rectifier/inverter) unit, with no interruption of power to the load on interruption and restoration of the "normal" source.
- L. VRLA: Valve-regulated lead acid.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and rating of central battery equipment unit.
  - 1. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, shipping splits, and furnished options, specialties, and accessories.
  - 2. Sample Warranty: For special warranty
- B. Shop Drawings: For each type and rating of central battery equipment unit.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
  - 3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.

4. Include elevation, details, and legends of control and indication displays.
5. Include -circuit current (withstand) rating of unit.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For central battery equipment to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing central battery equipment.
    - b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
    - c. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points
- B. Field quality-control reports.
- C. Performance Test Reports: Indicate test results compared with specified performance requirements.
- D. Warranty Documents: For special warranty.

#### 1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70 and NFPA 101.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to the authorities having jurisdiction and marked for intended location and application.
- C. UL Compliance: Listed and labeled under UL 924.
- D. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in fully enclosed vehicles.
- B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

#### 1.7 FIELD CONDITIONS

- A. Product Selection for Restricted Space: Refer to Drawings to determine maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items. Equipment layout and clearances are based upon the dimensions of the product regarded as the Design Basis. If an approved alternate manufacturer is provided, this contractor shall be fully responsible for ensuring that equipment dimensions and clearance requirements are compatible with the contract application and installation.

#### 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.
  1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
    - a. Central Battery Equipment (excluding Batteries): Two (2) years.
      - 1) If the manufacturer's warranty commences upon the date materials are delivered, then the warranty must exceed the above specified value to provide the full term calculated from the date of Substantial Completion.
    - b. Standard VRLA Batteries:
      - 1) Full Warranty: One (1) year.
      - 2) Pro Rata: Nine (9) years.



## PART 2 - PRODUCTS

### 2.1 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Chloride Power Protection; Signify Corp.
  2. Cooper Industries, Inc. (Sure-Lites).
  3. Controlled Power Company (EON), Emerson Co.
  4. Crucial Power Products
  5. Eaton Corporation (Powerware).
  6. Emergi-Lite (Emerg-Power Systems FTC Series), Thomas & Betts.
  7. Evenlite (Lifeguard)
  8. Hubbell Lighting (Dual-Lite).
  9. Liebert.
  10. Lithonia Lighting, Acuity Brands, (IOTA).
  11. Myers Power Products, Inc.
  12. Online Power, Inc.
- B. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924/UL 924A – Life Safety for Emergency Backup Lighting.
  3. Comply with the following codes and standards:
    - a. CSA certified per UL1778
    - b. UL 924 and CSA 22.2 No. 107.1.
    - c. FCC rules and regulations, Part 15, Subpart J, Class A
    - d. International Building Code (IBC)
    - e. NEMA PE-1
    - f. NFPA 70 (National Electrical Code)
    - g. NFPA 101 (Life Safety Code)
    - h. ANSI C62.41 (IEEE 587)
    - i. ANSI C62.42.45 (Cat. A and B)
    - j. TVSS UL1449 4th Editions - UL Standard for Safety Transient Voltage Surge Suppressors (Type 3, 4)
- C. Performance Requirements:
1. Fast-Transfer Central Battery Equipment: Passive standby (off-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 2-4 ms or less from normal supply to battery-inverter supply.
  2. Automatic Operation:
    - a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.
    - b. Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
    - c. If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
    - d. If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.
    - e. When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
    - f. If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.
    - g. If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.

- h. If battery is disconnected, and normal ac power is available, central battery equipment continues to supply power to the load with no degradation of its regulation of voltage and frequency of output bus.
- D. Connected Loads
- 1. Power Rating (kVA) as indicated on the Drawings.
  - 2. Load Types: Non-linear LED lighting as indicated on the Drawings.
  - 3. Unit shall be capable of meeting operating requirements for 100 percent of its specified power rating assuming 100 percent of each load type connected under this contract.
  - 4. If applicable, submittals shall include calculations and documentation of larger capacity models derated by manufacturer as necessary to achieve specified power ratings.
- E. Unit Operating Requirements:
- 1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of central battery equipment input voltage rating.
  - 2. Input Frequency Tolerance: Plus or minus 5 percent of central battery equipment frequency rating.
  - 3. Synchronizing Slew Rate: 1 Hz per second, maximum.
  - 4. Minimum Normal Off-Line Efficiency: 99 percent.
  - 5. Minimum Emergency Active On-Line Efficiency: 95 percent at full load.
  - 6. Minimum Displacement Primary-Side Power Factor: 95 percent under any load or operating condition.
  - 7. Ambient Temperature Rating (Other Than Batteries): Not less than 68 deg F and not exceeding 86 deg F.
  - 8. Ambient Temperature Rating (Batteries): Not less than 32 deg F and not exceeding 104 deg F.
  - 9. Ambient Storage Temperature Rating (Batteries): Not less than 0 deg F and not exceeding 104 deg F.
  - 10. Humidity Rating: Less than 95 percent (noncondensing).
  - 11. Altitude Rating: Not exceeding 3300 feet.
  - 12. Off-Line Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
- F. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.
- G. Controls and Indication:
- 1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:
    - a. Normal power available.
    - b. Status of system.
    - c. Battery charging status.
    - d. On battery power.
    - e. System fault.
    - f. External fault.
  - 2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
    - a. Keypad: In addition to required programming and control keys, include the following:
      - 1) Keys for METER, CONTROL, PROGRAM, and CLEAR modes.
      - 2) Security Access: Provide electronic security access to controls through identification and password with at least two levels of access: View only; and view, operate, and service.
      - 3) Control Authority: Supports at least three conditions: Off, local manual control at unit and local automatic control at unit.
    - b. Digital Display: Plain-English language messages on a digital display; provide the following historical logging information and displays:
      - 1) Real-time clock with current time and date.
      - 2) Tests and Events Logs: Record and store up to 50 tests and events.
        - a) Dates.
        - b) Times.
        - c) Durations.
        - d) Output voltage and currents.
      - 3) Alarm Logs: Record and store up to 50 alarms.
        - a) Dates.
        - b) Times.

- c) Alarm type.
    - 4) Metering Functions: Display central battery equipment metering parameters including, but not limited to, the following:
      - a) Input and output voltage (V ac) and output current (A ac).
      - b) Battery voltage (V dc) and current (A ac).
      - c) Fault or alarming status (code).
      - d) Power output (VA).
      - e) Inverter load (W).
      - f) Ambient temperature (deg F).
      - g) System run time (cumulative days).
      - h) Inverter run time (cumulative minutes).
    - 5) Alarm Functions: Digital display mounted flush in unit door and connected to display central battery equipment parameters including, but not limited to, the following:
      - a) High/low battery charge voltage.
      - b) High/low input voltage.
      - c) Battery nearing low-voltage condition.
      - d) Battery low voltage.
      - e) High ambient temperature.
      - f) Inverter fault.
      - g) Output fault.
      - h) Output overload.
  - 3. Remote Signal Interfaces:
    - a. Remote Indication Interface: Programmable (Form C) dry-circuit relay output(s) (120-V ac, 2 A) for remote indication of the following:
      - 1) Fault or status indication.
      - 2) On bypass.
      - 3) Low battery.
    - b. Communications Interface: Factory-installed hardware and software to enable a remote PC to program central battery equipment and monitor and display status and alarms.
      - 1) Network Communications Ports: Ethernet.
- H. Self-Protection and Reliability Features:
  - 1. Input transient protection by means of surge suppressors to provide protection against damage from supply voltage surges as defined in IEEE C62.45, Category B and C.
  - 2. Integral, programmable, self-diagnostic and self-test circuitry; with alarms and logging.
  - 3. Battery deep-discharge and self-discharge protection; with alarms.
  - 4. Battery self-test circuitry; with alarms and logging.
- I. Integral Input Disconnecting Means and OCPD: Thermal-magnetic circuit breaker, complying with UL 489.
  - 1. Integrated Equipment Minimum Short-Circuit Current (Withstand) Rating: Match the rating of the panelboard from which each unit is served..
- J. Inverter:
  - 1. Description: Solid-state, high frequency PWM type (10 to 15 kHz), with the following operational features:
    - a. Automatically regulate output voltage to within plus or minus 3 percent, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 8 percent for 100 percent step-load changes.
    - b. Automatically regulate output frequency to within plus or minus 1 Hz, from no load to full load, at unity power factor, over the operating range of battery voltage.
    - c. Output Voltage Waveform: Sine wave with maximum 5 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
    - d. Inverter Overload Capability: 115 percent for 10 minutes; 125% for 30 seconds; 150 percent surge for 10 seconds.
    - e. Load Power Factor: 0.70 lead to 0.70 lag.
    - f. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.
- K. Rectifier/Battery Charger:
  - 1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.
  - 2. Maximum Battery Recharge Time from Fully Discharged State: 24 hours.

3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.
  - L. Batteries:
    1. Description: Standard VRLA batteries.
      - a. Capable of sustaining full-capacity output of inverter unit for the following minimum duration: 90 minutes.
    2. Battery Disconnect and OCPD: Manufacturer's standard.
  - M. Maintenance Bypass Systems:
    1. Maintenance Bypass Mode:
      - a. Internal; manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator selection at central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load or causing system instabilities.
    2. Bypass Overload Capability: 1.5 times the base load current.
  - N. Integral Output Disconnecting Means and OCPD:
    1. Single-Output OCPD: Thermal-magnetic circuit breaker, complying with UL 489; manufacturer's standard ratings based on unit output ratings.
- 2.2 ENCLOSURES
- A. Central Battery Equipment Enclosures: NEMA 250, to comply with environmental conditions at installed location.
    1. Dry and Clean Indoor Locations: Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.
    2. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment.
- 2.3 SOURCE QUALITY CONTROL
- A. Testing: Test and inspect central battery equipment according to UL 924 and UL 1778.
  - B. Factory Tests: Test and inspect assembled central battery equipment according to UL 924 and UL 1778. Affix standards organization's label. Include the following:
    1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
    2. Full-load test.
    3. Transient-load response test.
    4. Overload test.
    5. Power failure test.
  - C. Central battery equipment will be considered defective if it does not pass tests and inspections.
  - D. Prepare test and inspection reports.

### **PART 3 - EXECUTION**

- 3.1 EXAMINATION
- A. Examine areas, surfaces, and substrates to receive central battery equipment, with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
    1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.
  - B. Examine equipment before installation. Reject equipment that is wet, moisture damaged, or mold damaged.
  - C. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
  - D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Floor-Mounted Central Battery Equipment: Install central battery equipment on 4-inch nominal-thickness concrete base.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Comply with NECA 1.
- E. Wiring Methods:
  - 1. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
  - 2. Conceal raceway and cables except in unfinished spaces.
  - 3. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
  - 4. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- F. Wiring within Enclosures:
  - 1. Power Wiring: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
  - 2. Control Wiring: Bundle, train, and support wiring in enclosures.

### 3.3 CONNECTIONS

- A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.
- B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
  - 1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.
- C. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 IDENTIFICATION

- A. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label central battery equipment with engraved nameplates.
  - 3. Label each separate cabinet, for multi-cabinet units.
  - 4. Label each enclosure-mounted control and pilot device.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Acceptance Testing Preparation:
  - 1. Inspect and Test Each Component:
    - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
    - b. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
    - c. Test continuity of each circuit.

- D. Tests and Inspections:
    - 1. Inspect central battery equipment, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
    - 2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
    - 3. Test continuity of each circuit.
    - 4. Verify that input voltages and frequencies at central battery equipment locations are within voltage and frequency limits specified in Part 2. If outside this range, notify Construction Manager before closing input OCPDs.
    - 5. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.
    - 6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
    - 7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
  - E. Central battery equipment will be considered defective if it does not pass tests and inspections.
  - F. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- 3.6 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service.
    - 1. Complete installation and startup-checks according to manufacturer's written instructions.
- 3.7 ADJUSTING
- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
  - B. Set field-adjustable switches, auxiliary relays, and other adjustable parts.
  - C. Adjust the trip settings of thermal-magnetic circuit breakers with adjustable, instantaneous-trip elements; install fuses if not factory installed.
  - D. Set the automatic system test parameters.
  - E. Set field-adjustable, circuit-breaker trip ranges as specified in Section 26 05 70 "Overcurrent Protective Device Studies."
- 3.8 PROTECTION
- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
  - B. Replace central battery equipment whose interiors have been exposed to water or other liquids prior to Substantial Completion.
- 3.9 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions. Video-recording may be excluded from this Section.

END OF SECTION 26 33 23

## SECTION 26 41 13

### LIGHTNING PROTECTION FOR STRUCTURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes lightning protection system for ordinary structures.

##### 1.2 ACTION SUBMITTALS

- A. Delegated Design Submittal signed and sealed by qualified electrical professional engineer.
- B. Product Data: For each type of product.
- C. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  - 2. Include raceway locations needed for the installation of conductors.
  - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  - 4. Include roof attachment details, coordinated with roof installation.
  - 5. Calculations required by UL 96A, 6 foot (1.8m) rule for bonding of metal bodies.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 01 78 39 "Project Record Documents."
    - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: UL-listed installer, category OWAY

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Heary Bros. Lightning Protection Co. Inc.
  - 2. National Lightning Protection.
  - 3. Preferred Lightning Protection.
  - 4. Thompson Lightning Protection, Inc.
  - 5. Franklin Lightning Protection

##### 2.2 PERFORMANCE REQUIREMENTS

- A. Nfpa 780 4.1.1.1.1 Structures not exceeding 75 ft (23 m) in height shall be protected with Class I materials as shown in Table 4.1.1.1.1.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class II buildings.

- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

## 2.3 MATERIALS

- A. Air Terminals:
  - 1. Solid Copper unless otherwise indicated.
  - 2. 1/2-inch diameter by 10 inches long minimum.
  - 3. Rounded tip.
  - 4. Threaded base support.
- B. Class 1 Main Conductors:
  - 1. Stranded Copper: 57,400 circular mils in diameter.
- C. Class II Main Conductors:
  - 1. Stranded Copper: 115,000 circular mils in diameter.
- D. Secondary Conductors:
  - 1. Stranded Copper: 26,240 circular mils in diameter.
- E. Ground Loop Conductor: Tinned copper.
- F. Ground Rods:
  - 1. Material: Copper-clad steel.
  - 2. Diameter: 3/4 inch.
  - 3. Rods shall be not less than 120 inches long.
  - 4. Sectional type, with integral threads.
- G. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A.
- B. Air terminals shall be installed to extend 10" above the protected area.
- C. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
- D. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed installations in UL 96A.
  - 1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
  - 2. Install conduit where necessary to comply with conductor concealment requirements.
  - 3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- E. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

### 3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: exothermic weld.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.



3.3 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports and certificates.

END OF SECTION 26 41 13

## SECTION 26 51 00

### LIGHTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. LED interior lighting.
  - 2. LED exterior lighting.
  - 3. Exit lighting.
  - 4. Luminaire accessories and support components.
- B. Related Requirements:
  - 1. Section 26 09 23 "Lighting Control Systems and Devices" for automatic control of lighting, including controllers/dimmers, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

##### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. EPA: Effective projected area (as it relates to the wind force exerted on an object, in accordance with the standard, AASHTO LTS-6).
- D. Fixture: See "Luminaire."
- E. IP: International Protection or Ingress Protection Rating.
- F. LED: Light-emitting diode.
- G. Lumen: Measured delivered output of luminaire.
- H. Luminaire: Complete lighting unit, including light source, reflector, integral or remote driver, internal or external emergency power unit, circuitry, lens, diffuser, housing, and accessories.

##### 1.3 PRICING

- A. Lighting Quotations: Only line-item pricing for each unique fixture type will be accepted.
  - 1. Use the same luminaire designations as indicated on Drawings.
  - 2. Arrange in order of luminaire designation.
  - 3. Include the contractor's price for each individual fixture.
  - 4. Include the quantity of each unique fixture type.
  - 5. Include the total cost for each fixture type (unit cost x quantity).
  - 6. All lighting control costs to be provided in a separate section of the quotation except for integral control components provided from the fixture manufacturer.
  - 7. All labor costs to be provided in a separate section of the quotation.
  - 8. All additional hard costs associated with the lighting and lighting control systems are to be identified and provided in a separate section of the quotation.

##### 1.4 SUBSTITUTIONS

- A. Provide in accordance with provisions set out in SECTION 01 25 00 - SUBSTITUTION PROCEDURES.
- B. Additional Product Data: For each type of product where the contractor can demonstrate cost savings to the owner and/or accelerated delivery. Failure to meet these requirements and those requirements listed within the lighting documents may result in rejected substitutions.
  - 1. Use the same luminaire designations as indicated on Drawings.
  - 2. Arrange in order of luminaire designation.
  - 3. Include data on features, accessories, and finishes.
  - 4. Include physical description, profiles, and dimensions of luminaires.
  - 5. Include data on EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 6. Include finishes for lighting poles and luminaire-supporting devices.

7. Include life, output (delivered lumens, CCT, TM30, and CRI), and energy-efficiency data.
8. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-79 and IES LM-80.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Arrange in order of luminaire designation.
  2. Include data on features, accessories, and finishes.
  3. Include physical description, profiles, and dimensions of luminaires.
  4. Include data on EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  5. Include finishes for lighting poles and luminaire-supporting devices.
  6. Anchor bolts.
  7. Include life, output (delivered lumens, CCT, TM30, and CRI), and energy-efficiency data.
  8. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-79 and IES LM-80.
  9. Use the same luminaire designations as indicated on Drawings.
- B. Shop Drawings: For nonstandard or custom luminaires or pole-mounted luminaires.
  1. Use the same luminaire designations as indicated on Drawings.
  2. Include plans, elevations, sections, unique configurations, and mounting and attachment details.
  3. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  4. Include diagrams for power, signal, and control wiring.
  5. Include delivered lumen outputs and CCT/TM30 values.
  6. Include all information for accompanying accessories.
- C. Finish/Color Samples for Initial Selection or Verification: Provide finish/color samples of substituted luminaires upon request.

#### 1.6 maintenance material submittals

- A. Provide signed log of extra luminaires provided to the owner as Attic Stock. Luminaire quantities as follows:
  1. (2) Type BA1
  2. (1) of each Type BA2, BB1, BD1
  3. (1) of each Type RA1, RA2, RA3, RB1, RC1
  4. (1) of each Type RD1, RD2
  5. (1) of each Type RT1A, RT1B, RT2A, RT2B, RT2C
  6. (1) of each Type TS1, TS2, TS3
  7. (1) of each Type X1, X1B, X1M, X2

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires, poles, and lighting systems to include in operation and maintenance manuals.
- B. Warranty documents.

#### 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
  1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
  2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- B. IESNA RP-16-05 Addendum "A": Industry-standard nomenclature and definitions of lighting terms and lighting technologies, including solid-state (LED) luminaires.
- C. UL Compliance: Comply with UL 1598 and listed for wet locations, as specified.
- D. Source Limitations:
  1. Provide luminaires from a single manufacturer for each luminaire type.
  2. Obtain poles from single manufacturer or producer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- B. Package aluminum poles for shipping according to ASTM B660.
- C. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- D. Retain factory-applied pole wrappings on poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Structural failures, including luminaire support components.
  - 2. Faulty operation of luminaires and accessories.
  - 3. Deterioration or corrosion of metals, metal finishes, color retention, and other materials beyond normal weathering.
- B. Luminaire and Pole Warranty Period: Greater than four (4) years from date of Substantial Completion.
  - 1. If the manufacturer's warranty commences upon the date materials are delivered, then the manufacturer's warranty period must be at least five (5) years to meet the requirement stated above.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-6-M.
- B. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- C. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- D. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- E. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
- F. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- G. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- H. Ambient Temperature (Indoor Lighting): 5 to 104 deg F.
- I. Exterior Temperature (Outdoor Lighting): minus 20 to plus 120 deg F (-29 to +50 deg C).
  - 1. Relative Humidity: Zero to 95 percent.
- J. Altitude: Sea level to 500 feet.

2.2 LUMINAIRE REQUIREMENTS

- A. Luminaire Types and Acceptable Manufacturers: As indicated on the Drawings. Refer to the Luminaire Schedule.
  - 1. Model numbers shall not be regarded as complete or entirely accurate. Do not order products based solely on a model number. For each luminaire type, the contractor shall reconcile its description, including options and accessories, with its intended application derived from relevant information conveyed throughout the entirety of contract documents.
  - 2. The manufacturer listed first for each luminaire type shall be regarded as the Basis of Design. Alternative products by other listed manufacturers must be at least equivalent in style, quality, features, and performance to that of the Basis of Design.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Factory-Applied Labels: Comply with UL 1598. Include CCT, TM30 and CRI ratings. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - D. Recessed luminaires shall comply with NEMA LE 4.
- 2.3 LED LUMINAIRES
- A. Delivered lumen output as indicated on the Luminaire Schedule.
  - B. IESNA LM-79 compliant, latest edition.
  - C. IESNA LM-80 compliant, latest edition; 50,000 hours minimum, unless otherwise noted.
  - D. CRI, CCT, and TM30 as indicated on Luminaire Schedule in accordance with ANSI C78.377.
  - E. NEMA.SSL-1 compliant for operational characteristics and electrical safety of LED drivers and power supplies. ANSI/NEMA C82.77 compliant for maximum allowable harmonic distortion produced by power supplies/drivers.
  - F. Power Factor > 0.9, unless noted otherwise.
  - G. Total Harmonic Distortion (THD) < 20%, unless noted otherwise.
  - H. Provide integral Type 4 surge protective device (SPD) rated for 10 kA peak surge per UL 1449 standards.
- 2.4 EXIT SIGNS
- 1. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
  - 2. Internally Lighted Sign:
    - a. LED; 100,000 hours minimum rated lamp life.
- 2.5 MATERIALS
- A. Metal Parts:
    - 1. Free of burrs and sharp corners and edges.
    - 2. Sheet metal components shall be steel unless otherwise indicated.
    - 3. Form and support to prevent warping and sagging.
  - B. Steel:
    - 1. ASTM A36/A36M for carbon structural steel.
    - 2. ASTM A568/A568M for sheet steel.
    - 3. Epoxy-coated.
  - C. Stainless Steel:
    - 1. Manufacturer's standard grade.
    - 2. Manufacturer's standard type, ASTM A240/240M.
  - D. Galvanized Steel: ASTM A653/A653M.
  - E. Aluminum: ASTM B209. Corrosion-resistant.
  - F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit servicing without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during servicing and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
  - G. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation (UV-stabilized). Lens Thickness: At least 0.125 inch minimum, unless otherwise indicated.
  - H. Glass Lenses, Diffusers, or Globes: Annealed crystal glass, tempered Fresnel glass, unless otherwise indicated. Acrylic lenses
- 2.6 FINISHES
- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
  - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Finishes and Color Selections: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping.
    - 1. Finishes/colors to be selected by the Architect/Interior Designer/Lighting Designer/Engineer from the manufacturer's full range of standard finishes/colors during the review of action submittals, unless the color is specifically indicated on the Luminaire Schedule.
    - 2. If noted on the Luminaire Schedule, provide custom color matching color sample or RAL designation.
    - 3. For pole-mounted luminaires, match finish process and color of pole, unless otherwise indicated.
  - D. Factory-Applied Finish for Aluminum Luminaires and Poles: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
    - 2. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  - E. Factory-Applied Finish for Steel Luminaires and Poles: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
    - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
  - F. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
    - 1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
    - 2. Powder Coat: Comply with AAMA 2604. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mil dry film thickness. Coat interior and exterior of pole for equal corrosion protection
- 2.7 integral control
- A. Manufacturer of luminaires shall install integral control as specified on Interior and Exterior Luminaire Schedules. Where specified UL924 listed relay shall be factory installed for bypass of dimming and activation to 100 percent for indicated luminaires. Each luminaire shall have two connection ports for control bus. Connections shall be daisy chained from fixture to fixture. Control shall be compatible with system specified in Section 26 09 23.
    - 1. Where "WIRELESS" is indicated on luminaire schedule, provide factory installed integral control.
- 2.8 LUMINAIRE SUPPORT
- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
  - B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
  - C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12-gage.
  - D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
  - E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.
- 2.9 POLES
- A. Pole Manufacturers: Subject to compliance with requirements:
    - 1. Valmont.
    - 2. WJM Poles.
    - 3. Cooper Lighting.
    - 4. Kim Lighting.
    - 5. Or same manufacturer as pole-mounted luminaire.

- B. Pole Heights: As indicated on the Drawings. Refer to the Luminaire Schedule.
- C. Concrete Base: Refer to the Drawings.
- D. Structural Characteristics: Comply with AASHTO LTS-6.
  - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article.
  - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
  - 3. The minimum EPA capacity of each pole shall exceed 200% of the total fixture head EPA value attached to each pole at 90 mph. This provides a safety factor, as well as countering long-term fatigue and/or accommodating an additional fixture head in the future.
- E. Steel Poles
  - 1. Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
    - a. Shape: As indicated on drawings
    - b. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
  - 1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dipped galvanized after fabrication unless otherwise indicated.
- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- H. Pole Accessories: Provide for each pole, unless indicated otherwise on the Drawings.
  - 1. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
  - 2. Provide watertight pole cap atop each pole.
  - 3. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.
  - 4. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.
- I. Mounting Hardware
  - 1. Anchor Bolts: Manufactured to ASTM F1554, Grade 55 with a minimum yield strength of 55,000 psi (380 000 kPa).
    - a. Galvanizing: Hot-dipped galvanized according to ASTM A153, Class C.
    - b. Threading: Uniform National Coarse, Class 2A.
  - 2. Nuts: ASTM A563, Grade A, Heavy-Hex.
    - a. Galvanizing: Hot-dipped galvanized according to ASTM A153, Class C.
    - b. Two (2) nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
  - 3. Washers: ASTM F436, Type 1.
    - a. Galvanizing: Hot-dipped galvanized according to ASTM A153, Class C.
    - b. Two (2) washers provided per anchor bolt.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, roofs, canopy ceilings, and overhang ceilings for suitable conditions where luminaires will be installed.

- D. Examine poles, luminaire-mounting devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.
- C. Coordinate layout and installation of luminaires with other construction. Do not modify layout or locations of luminaires without documented approval to do so, unless indicated otherwise on the Drawings.
- D. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- E. Locate cove lighting at front of cove unless otherwise indicated or directed.
- F. Located undercabinet lighting near the front of the cabinet and aimed toward the wall unless otherwise indicated.
- G. Adjust luminaires that require field adjustment or aiming to provide optimum illumination. Coordinate and confirm final adjustments with Owner and Design Team during Aiming & Focusing.
- H. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- I. Fasten luminaire to structural support.
- J. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and servicing.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- K. Flush-Mounted Luminaires:
  - 1. Secured to junction box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- L. Wall-Mounted Luminaires:
  - 1. Secured to junction box.
  - 2. Attached to structural members in walls or a minimum 20-gauge or 1/8-inch thick backing plate attached to wall structural members.
  - 3. Attached using through bolts and backing plates on either side of wall as recommended by luminaire manufacturer.
  - 4. Do not attach luminaires directly to gypsum board.
- M. Suspended Luminaires:
  - 1. Pendant mount, where indicated, minimum 5/32-inch-diameter aircraft cable supports, adjustable, and quantity of supports as indicated or as recommended by luminaire manufacturer, whichever is greater.
  - 2. Mount suspended fixtures at elevations indicated on Drawings or as directed by Design Team. Provide a minimum of 12 inches of aircraft cable and power cable length hidden from view above the ceiling or within the junction box to allow for future height adjustments.
  - 3. Hook mount, where applicable.
  - 4. Rods: Where longer than 48 inches, brace to limit swinging.
  - 5. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved junction box and accessories that hold stem and provide damping of luminaire oscillations. Support junction box vertically to building structure using approved devices.
  - 6. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod or wire support as indicated for suspension for each unit length of luminaire chassis, including one at each end.
  - 7. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- N. Ceiling-Grid-Mounted Luminaires:
  - 1. Secure to any required junction box.



2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- O. Ground-Mounted luminaires:
1. Install on concrete base, per base detail in Drawings, at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified under Division 03.
- P. Pole-Mounted luminaires:
1. Where applicable, adjust photoelectric devices to prevent false operation of relay by electric light sources, favoring a north orientation.
- Q. Poles Foundations:
1. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."
  2. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."
  3. Anchor Bolts: Install plumb using manufacturer-supplied steel or plywood template, uniformly spaced.
- R. Pole Installation:
1. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
  2. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
    - a. Fire Hydrants and Water Piping: 60 inches.
    - b. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
    - c. Trees: 15 feet from tree trunk.
  3. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified under Division 03.
  4. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
    - a. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
    - b. Install base covers unless otherwise indicated.
    - c. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
  5. Poles and Pole Foundations Set within Paved Areas: Install poles foundations level with surrounding paving unless a different paving material is intended to be continuous in which case locate the top of the foundation below the final paving material thickness.
  6. Poles and Pole Foundations Set Adjacent to Paved Areas/Curb: Install poles foundations 8" above finished grade. Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1-inch below top of concrete slab.
  7. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.
- S. Pole Grounding: Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
1. Install grounding electrode for each pole unless otherwise indicated.
    - a. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
    - b. Install grounding conductor and conductor protector.
    - c. Ground metallic components of pole accessories and foundation.
- 3.3 CORROSION PREVENTION
- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify settings, programming, functions, and operation of components integral to the luminaire, whether dimming drivers, integral presence sensors, or photoelectric sensors—in addition to other control systems specified in Section 26 09 23 "Lighting Control Systems and Devices."
  - 3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency power and retransfer to normal.
  - 4. Inspect luminaires and poles for nicks, mars, dents, scratches, and other damage.
- C. Luminaire will be considered defective if it does not pass operation tests and inspections.
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 STARTUP AND SYSTEMS COMMISSIONING

- A. Comply with requirements for startup and system commissioning specified in Section 26 08 00 "Commissioning of Electrical Systems."
- B. Newly installed lighting is not intended to be used for 24/7 construction and security lighting. Building lighting may be used during normal hours but must be turned off afterhours and supplemental lighting to be provided by the Contractor.
- C. AIMING & FOCUSING
  - 1. All adjustable lighting units shall be aimed, focused, locked, etc., by the Contractor under the supervision of the Lighting Designer. The Lighting Designer shall indicate the number of crews (foreman and apprentice) required. All aiming and adjusting shall be carried out after the installation is complete, including finishes and architectural/interior design elements being illuminated. All ladders, scaffolds, lift equipment, safety belts, flashlights, walkie talkie equipment, etc. required shall be furnished by the Contractor at the direction of the Lighting Designer. As aiming and adjusting is completed, locking set screws and bolts and nuts shall be tightened securely.
  - 2. Contractor shall provide before the start of aiming, all accessories that were ordered for each fixture type installed. This includes but is not limited to optics, lenses (soft focus, linear spread, etc.), louvers, snoots, barndoors, filters, etc. Contractor to organize and label all leftover components and return to owner for future use.
  - 3. Night work: Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing the full lighting effect, aiming shall be accomplished at night.
- D. CLEANING
  - 1. Thoroughly clean each installed luminaire within one month after substantial completion.

END OF SECTION 26 51 00

## SECTION 27 05 00

### COMMON WORK RESULTS FOR COMMUNICATIONS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Raceway and Boxes for Communications.
  - 2. Sleeves for pathways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common communications installation requirements.
  - 6. Backboxes, raceways and power for all communications systems shown on Contract Drawings.
- B. This Section includes the following types of system rough-ins:
  - 1. Audiovisual outlets.
  - 2. Combination voice/data/video outlet.
  - 3. Intercom speaker.
  - 4. Intercom volume control.
  - 5. TV receptacles.
  - 6. Wall mounted telephone.
- C. Related Sections:
  - 1. Section 26 05 33 "Raceway and Boxes for Electrical Systems" for raceway and outlet boxes.
  - 2. Section 27 51 23.50 "Educational Intercommunications and Program Systems" for raceway, boxes and backboxes.
  - 3. Section 27 41 16 "Integrated Audiovisual Systems" for raceway, outlet boxes and backboxes.

##### 1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

##### 1.3 SUBMITTALS

- A. Product Data: None.

##### 1.4 COORDINATION

- A. Coordinate installation of low voltage equipment and cabling to insure timely and accurate installation. Provide as-built drawings of rough-in and raceway routings provided under this Section.
- B. Coordinate arrangement, mounting, and support of communications equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.
- E. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 07 84 13 "Penetration Firestopping."
- F. Coordinate rough-ins with surrounding surfaces to insure flush installations. Provide clearances to walls and marker boards to accommodate width of communications devices. Provide extension rings on device boxes to accommodate tack walls and surfaces.
- G. Coordinate ducts and sleeves with structural and building systems.

1.5 MATRIX OF RESPONSIBILITY

				In Contract				NOTES
				Not Applicable	Not In Contract (NIC)	Owner Provided	G.C. Provided	
<b>5.0 TECHNOLOGY EQUIPMENT</b>								
	CATV Distribution System				X		X	
	Ceiling Mounted Projectors				X		X	
	Ceiling Projector Mounts				X		X	
	Smart Boards	X						No smartboards on project
	Classroom Sound & Control				X		X	
	Clocks (Wireless, Synchronized)		X	X		X		
	Network Hardware							
	Switches, Servers		X	X		X		
	UPS		X	X		X		Crandall will provide UPS for power coordination
	Fiber Optic Backbone				X		X	Fiber from MDF to new IDF- <b>JL Technology Group</b>
	Wireless Access Points (WAP)							Heat map provided by vendor. DLR Group will show locations.
	Cabling				X		X	JL Technology Group
	WAP		X	X			X	
	Data / Communications Cabling				X		X	
	Intrusion Detection System		X	X		X		Rough-ins and pathways, <b>Electrical contractor will provide the pathways</b>
	Access Control System		X	X		X		Rough-ins and pathways, <b>Electrical contractor will provide the pathways</b>
	Video Surveillance							
	Cabling				X		X	<b>JL Technology Group</b>
	Cameras		X	X		X		
	Network Servers		X	X		X		
	Fiber Optic WAN to Building		X					
	Communications Tower	X						
	Telephones/Telephone System				X		X	
	Distributed Antenna System				X		X	
	Public Safety				X		X	
	Cellular	X						
	Intercom/Paging System				X		X	Speakers, cabling, and pathways. Bogen system

**PART 2 - PRODUCTS**

2.1 RACEWAY AND BOXES FOR COMMUNICATIONS

- A. All material and associated installation shall be as specified in appropriate Sections 26 05 33 "Raceways and Boxes for Electrical Systems" unless noted otherwise.
- B. Plaster rings or mud rings for all communications outlet boxes shall be as shallow as possible and have square corners to accommodate large devices.

2.2 SLEEVES FOR PATHWAYS AND CABLES

- A. See Section 26 05 33 "Raceways and Boxes for Electrical Systems".
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends with finish bushings.

### 2.3 CABLE SUPPORTS FOR CABLE PATHWAYS

- A. Cable Supports (J-Hooks): Meets ISO/IEC 18010 and TIA-569. Steel hooks designed for communications cable support with cable retaining clip. Supports shall be capable of interlocking vertically to support multiple cable pathways. Supports shall be available in 1 inch thru 4 inch size. Supports shall be capable of attaching to beams, walls, threaded rod, and angled mounting brackets with compatible accessories.
  - 1. Provide single J-Hook cable supports from each communications cable stub-up to main cable support line or cable tray.
  - 2. Provide three (3) stacked cable supports minimum 5ft on center from individual rooms along main pathways to cable tray or serving communications room.
  - 3. Provide Erico Caddy CAT Link Series or approved equal.
- B. Cable drop-out for sleeves. Formed radius bend water-fall element designed to support cables as they enter or exit from 4 inch cable tray extension sleeves.
  - 1. Provide Panduit CWF-400 raceway attached cable drop-out.

### 2.4 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. General:
  - 1. Comply with NECA 1.
  - 2. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
  - 3. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.
  - 4. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications' equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
  - 5. Right of Way: Give to piping systems installed at a required slope.
  - 6. Provide rough-ins as specified herein at each location where the corresponding symbol is indicated on the Drawings.
  - 7. Recessed communications raceways shall be routed directly up from the location indicated on Drawings with a sweep bend above the APC of the room served. Raceways shall not be routed underground unless indicated on the Drawings.
  - 8. Mounting heights shall be as indicated in the Symbols sheet unless otherwise indicated on the Drawings.
  - 9. Provide all raceways with protective insulation bushings at raceway terminations and with continuous pull strings. All raceways shall be installed with sweep bends.

10. Ream junction, pullbox and outlet assembly knock-outs to maintain raceways inside diameter through to box interior.
  11. Provide junction/pull boxes where indicated or required. Any pull/junction box shall not be used to change raceway routing direction. Directional changes shall be provided only with sweep bent raceway.
  12. Coordinate floor box communications raceway routing with floor box dividers to separate Class I and Class II wiring within the box.
  13. Install under slab raceway stub-ups at locations indicated on Drawing and within 2 inches of finished wall surface for exposed stub-ups. Trim raceways 8 inches above finished floor and label with location served.
  14. Provide a blank coverplate for each rough-in not utilized by date of substantial completion. Including all outlet locations along divided surface raceways.
- B. Audiovisual Outlets:
1. Provide audiovisual outlets and pathways as specified in Section 27 41 16 and shown on audiovisual sheets.
- C. Combination Voice/Data/Video Outlet (See Drawing details):
1. Provide flush 4-11/16 inch square steel box with a single-gang plaster ring for voice, data and video devices.
  2. Provide one (1) 1-1/4 inch raceway stubbed directly up into accessible ceiling space or to nearest cable tray from each backbox. Include bushings at all raceway terminations.
- D. Intercom speaker:
1. Speaker backboxes specified under Section 27 51 23.50 "Educational Intercommunications and Program Systems."
  2. Provide one (1) 3/4-inch raceway between backboxes and to above nearest accessible ceiling space or to nearest cable tray. Coordinate location with intercom installer.
- E. Intercom volume control:
1. Provide flush 4-inch square steel box with a single-gang plaster ring for volume control device.
  2. Provide one (1) 3/4-inch raceway stubbed directly up into accessible ceiling space or to nearest cable tray from each backbox. Include bushings at all raceway terminations.
- 3.2 TV OUTLETS:
- A. Provide flush 4-11/16 inch square steel box with a single-gang plaster ring for wall-mounted TV devices.
1. Provide one (1) 1-inch raceway stubbed up into accessible ceiling space from each backbox. Include bushings at all raceway terminations.
- B. Wall Mounted Telephone (See Drawing details):
1. Provide flush single-gang backbox with a single-gang plaster ring for wall-mounted telephone locations.
  2. Provide a 3/4-inch raceway stubbed up into accessible ceiling space or to nearest cable tray from each backbox. Include bushings at all raceway terminations.
- 3.3 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. General:
1. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
  2. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
  3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  4. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
  5. Cut sleeves to length for mounting flush with both surfaces of walls unless sleeves are shown across inaccessible ceiling or meeting cable tray.
  6. Seal space outside of sleeves with grout for penetrations of concrete and masonry
    - a. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
  7. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants".

8. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with removable firestop materials. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
  9. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work. See architectural detail.
  10. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  11. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.
  12. Sleeves for communications cabling (from Classrooms, Offices, etc.): Where sleeves meet cable tray, install sleeves above cable tray and within 12 inches of cable tray side.
  13. Sleeves for cable tray extension shall be stacked and located within two (2) inches vertically of cable tray. Align sleeves directly in line with cable tray. Sleeves shall not extend horizontally more than 2 inches beyond the width of the cable tray. See detail on drawings.
  14. Where sleeves penetrate a wall with one side having exposed structure, sleeves shall be placed above the elevation of the bottom of steel. Where a roof deck elevation change occurs, sleeve height shall vary and be installed above the elevation of bottom of steel on both sides of wall.
- B. Sleeves: Provide communication sleeves where needed to provide a route from each system rough-in to the nearest communication closet and as noted below. Provide additional sleeves for intercom cabling. These sleeves not shown on drawings. Each group of sleeves shall be located to minimize the length of cabling to serve the associated devices in each room or area. Provide the quantity and size of sleeves as defined below and as indicated in locations specified on Drawing:
1. Rooms with five or less system device rough-ins: Two (2) 2-inch sleeves.
  2. Rooms with six to ten systems device rough-ins: Three (3) 2-inch sleeves.
  3. Rooms with eleven to fifteen system device rough-ins: Four (4) 2-inch sleeves.
- C. Cable Tray Sleeves: Provide sleeves where cable tray passes thru rated walls or provides access into communication rooms or provide other fire protection means as specified. The quantity of sleeves shall be such that the sum of adding 40 percent of the area of each sleeve shall equal or exceed an area equal to 40 percent of the cross sectional area of the cable tray.
1. Provide cable drop-out on each sleeve extending into communications room.
- 3.4 SLEEVE-SEAL INSTALLATION
- A. Install to seal exterior wall penetrations.
  - B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- 3.5 FIRESTOPPING
- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Utilize non-hardening putty or pillows to allow removal and installation. Firestopping materials and installation requirements are specified in Section 07 84 13 "Penetration Firestopping."

END OF SECTION 27 05 00

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Optical-fiber-cable pathways and fittings.
  - 4. Metal wireways and auxiliary gutters.
  - 5. Nonmetallic wireways and auxiliary gutters.
  - 6. Surface pathways.
  - 7. Boxes, enclosures, and cabinets.
- B. Related Sections:
  - 1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for floor boxes

1.2 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.3 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.



## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by and not limited to, the following:
1. AFC Cable Systems, Inc.
  2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  3. Alpha Wire Company.
  4. Anamet Electrical, Inc.
  5. Electri-Flex Company.
  6. O-Z/Gedney; a brand of EGS Electrical Group.
  7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
  8. Republic Conduit.
  9. Southwire Company.
  10. Thomas & Betts Corporation.
  11. Western Tube and Conduit Corporation.
  12. Wheatland Tube Company; a division of John Maneely Company.
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with TIA-569.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew or compression.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

### 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements provide products by the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
  2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  3. Anamet Electrical, Inc.
  4. Arnco Corporation.
  5. CANTEX Inc.
  6. CertainTeed Corp.
  7. Condux International, Inc.
  8. Electri-Flex Company.
  9. Kraloy.
  10. Lamson & Sessions; Carlon Electrical Products.
  11. Niedax-Kleinhuis USA, Inc.
  12. RACO; a Hubbell company.
  13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with TIA-569.

- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type or Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

### 2.4 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.

### 2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman; a Pentair company.
  - 5. Hubbell Incorporated; Killark Division.
  - 6. Lamson & Sessions; Carlon Electrical Products.
  - 7. Mono-Systems, Inc.
  - 8. O-Z/Gedney; a brand of EGS Electrical Group.
  - 9. RACO; a Hubbell company.
  - 10. Spring City Electrical Manufacturing Company.
  - 11. Thomas & Betts Corporation.
  - 12. Wiremold / Legrand.

- B. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with TIA-569.
  - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Gangable boxes are prohibited.
- H. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

### PART 3 - EXECUTION

#### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC and IMC.
  - 2. Underground Conduit: RNC, Type EPC-40-PVC.
  - 3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Damp or Wet Locations: GRC.
  - 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway, Plenum-type, communications-cable pathway EMT.
  - 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts EMT.
  - 8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size, unless noted otherwise: 1-inch trade size. Minimum size for optical-fiber cables is 1 ¼-inch.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

#### 3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and below steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Pathways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- L. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- N. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- O. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- P. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid, and flexible, as follows:
  - 1. 1-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
  - 2. 1 1/4-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
  - 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- Q. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- R. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

- T. Expansion-Joint Fittings:
    - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
    - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
      - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
      - d. Attics: 135 deg F temperature change.
    - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
    - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
    - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
  - U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
  - V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
  - W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  - X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
  - Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
  - Z. Set metal floor boxes level and flush with finished floor surface.
  - AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 27 05 44 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- 3.4 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- 3.5 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage or deterioration.
    - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
    - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 27 05 28

## SECTION 27 11 00

### COMMUNICATIONS EQUIPMENT ROOM FITTINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Telecommunications mounting elements.
  - 2. Backboards.
  - 3. Telecommunications equipment racks and cabinets.
  - 4. Telecommunications service entrance pathways.
  - 5. Grounding.
- B. Related Requirements:
  - 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
  - 2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

##### 1.2 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches (152 mm) in width.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.
- H. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
  - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

- C. Qualification Data: For Installer(s), and qualified layout technician, installation supervisor, and field inspector.
- D. Seismic Qualification Certificates: For floor-mounted cabinets, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Field Inspector: Currently registered by BICSI as RCDD or Commercial Installer, Level 2, to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA-569.
- D. Grounding: Comply with TIA-607.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
  - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

### **PART 2 - PRODUCTS**

#### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA-569.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
  - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
  - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 3. Lacing bars, spools, J-hooks, and D-rings.

4. Straps and other devices.
  - C. Cable Trays:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Chatsworth.
      - b. Cooper B-Line, Inc.
      - c. Snake Tray
    2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by hot dip galvanizing, anodizing or power coating (no electro-galvanized tray shall be used in equipment rooms).
      - a. Basket Cable Trays: 24 inch by 6 inch, unless noted otherwise on drawings. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
      - b. Cable Ladder: 18 inches (455 mm) wide, and a rung spacing of 6 inches (150 mm), unless noted otherwise on drawings.
      - c. Channel Cable Trays: One-piece construction, aluminum, nominally 6 inches (150 mm) wide, unless otherwise noted on drawings. Solid bottom.
  - D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
    1. Outlet boxes shall be 4 11/16 square by 2 1/2 inches deep, with plaster, tile or surface "ring" to suit installation.
- 2.2 BACKBOARDS
- A. Backboards: Plywood, fire-retardant treated, A-C, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry." Mount A side facing the room and paint to match Wall Finish Schedule, after field verification of "fire Retardant" stamps.
- 2.3 EQUIPMENT FRAMES
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Chatsworth Products.
    2. Cooper B-Line, Inc.
    3. Middle Atlantic
  - B. General Frame Requirements:
    1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
    2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
    3. Finish: Manufacturer's standard, baked-polyester powder coat.
  - C. Floor-Mounted "Relay" Racks: Modular-type, steel or aluminum construction.
    1. Two vertical 6" cable managers with hinged covers and horizontal cable management channels, top and bottom cable troughs, grounding lug, and two power strips.
    2. Baked-polyester powder coat finish.
      - a. CPI 55053-703 2 post rack
      - b. CPI 35521-703 6" vertical mangers
      - c. CPI EO-1001-C basic vertical PDU
  - D. Modular Wall Cabinets:
    1. Wall mounting.
    2. Steel or aluminum construction.
    3. Treated to resist corrosion.
    4. Lockable front doors.
    5. Louvered side panels.
    6. Cable access provisions top and bottom.
    7. Grounding lug.
    8. Side-mounted, 250-cfm (118-L/s) fan.
    9. Power strip.
    10. All cabinets keyed alike.
      - a. CPI 12419-748 Cube-iT wall cabinet.
      - b. CPI 40972-001 Fan (2).
      - c. CPI 12816-705.
  - E. Cable Management for Equipment Frames:
    1. Metal, with integral wire retaining fingers.



2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with hinged covers.
4. Provide horizontal crossover cable managers as indicated on drawings, or not less than 6-2RU managers per rack and cabinet.
  - a. CPI 35522-703 8" vertical mangers.
  - b. CPI 35441-702 2U manager.

#### 2.4 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
  1. Connectors: Mechanical type, cast silicon bronze, exothermic or solderless 2-hole, 2-crimp compression wire terminals, with long-barrel(2-crimp), two-bolt connection to ground bus bar.
  2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
  3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with TIA-607.

#### 2.5 LABELING

- A. Comply with TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

### **PART 3 - EXECUTION**

#### 3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground, buried, and/or aerial pathways, where indicated on drawings, complying with recommendations in TIA-569, "Entrance Facilities" Article.

#### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with NEMA VE 2 and TIA-569-7.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

#### 3.3 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA-569, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

#### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
  1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA-606 for Class 4 level of administration including optional identification requirements of this standard.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 11 00

## SECTION 27 13 00

### COMMUNICATIONS BACKBONE CABLING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. UTP cable.
  - 3. 8.7/125-micrometer, optical fiber cabling.
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Cabling identification products.

##### 1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

##### 1.3 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-D.1, when tested according to test procedures of this standard.

##### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.

6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
  - C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
  - D. Source quality-control reports.
  - E. Field quality-control reports.
  - F. Maintenance Data: For splices and connectors to include in maintenance manuals.
  - G. Software and Firmware Operational Documentation:
    1. Software operating and upgrade manuals.
    2. Program Software Backup: On magnetic media or compact disk, complete with data files.
    3. Device address list.
    4. Printout of software application and graphic screens.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
    1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, and field testing program development by an RCDD.
    2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
    3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  - B. Testing Agency Qualifications: An NRTL.
    1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  - C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    1. Flame-Spread Index: 25 or less.
    2. Smoke-Developed Index: 50 or less.
  - D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - E. Telecommunications Pathways and Spaces: Comply with TIA-569.
  - F. Grounding: Comply with TIA-607.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
    1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
    2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
    3. Test each pair of UTP cable for open and short circuits.
- 1.8 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.9 COORDINATION
- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Patch-Panel Units: One of each type.
  - 2. Connecting Blocks: One of each type.

**PART 2 - PRODUCTS**

2.1 PATHWAYS

- A. General Requirements: Comply with TIA-569.
- B. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
  - 1. Pull boxes shall be arranged for straight pulls only, no pull box shall be used as a turning point for the cable run.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berk-Tek
  - 2. CommScope, Inc.
  - 3. Superior Essex Inc.
- B. Description: 100-ohm, pair count as indicated on the drawings UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA-568-D.1 for performance specifications.
  - 3. Comply with TIA-568-D.2, Category 5e.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, Riser Rated: Type CMP.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Leviton Voice & Data Division.
  - 2. CommScope, Inc.
  - 3. Panduit Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
  - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated or conductor group of indicated cables, plus spares and blank positions to suit a future expansion or 25%.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

- F. Patch Cords: Factory-made, 4-pair cables in 36-inch (900-mm) and 48-inch (1200-mm) lengths, 50% each; terminated with 8-position modular plug at each end, total quantity to match the installed quantity of jacks.
  - 1. Patch cords shall be factory manufactured, have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall be color-coded cables and boots for circuit identification.

#### 2.4 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berk-Tek
  - 2. CommScope, Inc.
  - 3. Corning Cable Systems.
  - 4. Hitachi Industries.
- B. Description: Single mode, 8.7/125-micrometer, type OS2, fiber count as indicted on the drawings, nonconductive, tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA-568-D.3 for performance specifications.
  - 3. Comply with TIA-492AAAA-A for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. Riser Rated, Nonconductive: Type OFNP, complying with UL 1666.
  - 5. Maximum Attenuation: 0.40 dB/km at 1310 nm; 0.30 dB/km at 1550 nm.
- C. Jacket:
  - 1. Jacket Color:
  - 2. Yellow for 8.7/125-micrometer cable.
  - 3. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
  - 4. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

#### 2.5 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Corning Cable Systems.
  - 2. Leviton
  - 3. CommScope, Inc.
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit 25% expansion.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- D. Cable Connecting Hardware:
  - 1. Comply with Fiber Optical Connector Intermate ability Standards (FOCIS) specifications of TIA-604-2, TIA-604-3-A, and TIA-604-12. Comply with TIA-568-D.3.
  - 2. Quick-connect, simplex and duplex, Type LC; as required to match active equipment (both contractor furnished and owner furnished) connectors. Insertion loss not more than 0.75 dB.
  - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

### PART 3 - EXECUTION

#### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible. Protect backbone cables in Inner-Duct or conduit for their entire runs between equipment/technology rooms and closets.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA-569 for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA-568-D.1.
  - 2. Comply with BICSI ITSIM, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
  - 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each cable.
  - 11. Pulling Cable: Comply with BICSI ITSIM, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
  - 1. Comply with TIA-568-D.2.
  - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
  - 1. Comply with TIA-568-D.3.
  - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

- E. Open-Cable Installation:
    - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
    - 2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
    - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
  - F. Installation of Cable Routed Exposed under Raised Floors:
    - 1. Install plenum-rated cable only.
    - 2. Install cabling after the flooring system has been installed in raised floor areas.
    - 3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
  - G. Group connecting hardware for cables into separate logical fields.
  - H. Separation from EMI Sources:
    - 1. Comply with BICSI TDMM and TIA-569 recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
    - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
      - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
      - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
      - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
    - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
      - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
      - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
      - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
    - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
      - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
      - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
      - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
    - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
    - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).
- 3.4 FIRESTOPPING
- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA-569, Annex A, "Firestopping."
  - B. Comply with BICSI TDMM, "Firestopping Systems" Article.
- 3.5 GROUNDING
- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
  - B. Comply with TIA-607.
  - C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
  - D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
- 3.6 IDENTIFICATION
- A. Identify system components, wiring, and cabling complying with TIA-606. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
    - 1. Administration Class: 4.
    - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.



- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion about TIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA-606 for Class 4 level of administration including optional identification requirements of this standard.
- D. Comply with requirements in Division 27 Section "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606, for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-D.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-D.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-D.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA-568-D.1.

- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 27 13 00

## SECTION 27 15 00

### COMMUNICATIONS HORIZONTAL CABLING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. UTP cable. Category 6A
  - 3. UTP cable. Category 6
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Telecommunications outlet/connectors.
  - 6. Cabling system identification products.
  - 7. Cable management system.
- B. Related Sections:
  - 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
  - 2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

##### 1.2 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlets/connectors.
- K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- L. RCDD: Registered Communications Distribution Designer.
- M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- O. UTP: Unshielded twisted pair.

### 1.3 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
  - 1. TIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
  - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

### 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-B.1, when tested according to test procedures of this standard.

### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
  - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration complete in faceplates for color selection and review of technical features.
- D. Qualification Data: For Installer, and qualified layout technician, installation supervisor, and field inspector.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Maintenance Data: For splices and connectors to include in maintenance manuals.
- H. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.

4. Printout of software application and graphic screens.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field-testing program development by an RCDD.
  2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
  3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
  1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  3. Flame-Spread Index: 25 or less.
  4. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA-569.
- E. Grounding: Comply with TIA-607.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.
  2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
  3. Test each pair of UTP cable for open and short circuits.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

#### 1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Patch-Panel Units: One of each type.
  2. Connecting Blocks: One of each type.
  3. Device Plates: One of each type.

## PART 2 - PRODUCTS

#### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA-569.

- B. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
  - 1. Outlet boxes shall be no smaller than 4 11/16-inch square, and 2-1/2-inches (64 mm) deep, with appropriate plaster/tile/surface ring to suit the box installation.

## 2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berk-Tek
  - 2. Superior Essex, Inc.
  - 3. Hitachi Industries.
- B. Category 6A: 100-ohm, 4-pair UTP covered with a blue thermoplastic jacket.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA-568 for performance specifications.
  - 3. Comply with TIA-568, Category 6A.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
    - b. Berk-Tek Lanmark SST
    - c. Superior Essex 10Gain XP+
- C. Category 6: 100-ohm, 4-pair UTP covered with a blue thermoplastic jacket.
  - 1. Comply with ICEA S-90-661 for mechanical properties.
  - 2. Comply with TIA-568 for performance specifications.
  - 3. Comply with TIA-568, Category 6.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
    - b. Berk-Tek Lanmark-6
    - c. Superior Essex

## 2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Leviton Voice & Data Division.
  - 2. Legrand Ortronics,
  - 3. Panduit Corp.
- B. General Requirements for Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements of Category 6A or Category 6 as appropriate.
  - 2. Comply with TIA-568-D.2, IDC type, with modules designed for punch-down caps or tools.
  - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from single source from single manufacturer.
- D. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
  - 1. Features:
    - a. Labeling areas adjacent to conductors.
    - b. Replaceable connectors.
    - c. Angled panel with 48 ports.
  - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
  - 3. Number of Jacks per Field: One for each four-pair cable indicated.
- E. Patch Cords: Factory-made, four-pair cables 50% 3' and 50% 5' at MDF rack and 100 % 10' at end point; terminated with an eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.
  - 3. Provide both sizes per each port/cable installed.

4. Category 6A White 3', 5' & 10' as noted above. Provide additional colors as required by owner.
  - F. Plugs and Plug Assemblies:
    1. Male; eight-position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
    2. Standard: Comply with TIA-568-D.2.
    3. Marked to indicate transmission performance.
  - G. Jacks and Jack Assemblies:
    1. Female; eight-position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
    2. Designed to snap-in to a patch panel or faceplate.
    3. Standard: Comply with TIA-568-D.2.
    4. Marked to indicate transmission performance.
    5. White in color to match plate.
    6. All under floor outlet locations shall be supplied with shutters or covers for dust and dirt protection.
  - H. Faceplate:
    1. Two-port or four-port, vertical single gang faceplates designed to mount to single gang wall boxes.
    2. Plastic Faceplate: High-impact plastic. White in color.
    3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
      - a. Flush mounting jacks.
        - 1) Leviton 42080-2WL 2 port, 42080-4WL 4 port or equivalent by other manufacturers.
      - b. Furniture Bezel (Confirm furniture manufacturer with Architect).
      - c. Surface box:
        - 1) Leviton 4S089-2WP 2 port WAP box with drop wire kit Leviton 49223-CBC or equivalent by other manufacturers.
      - d. Stainless Steel wall phone plate:
        - 1) Leviton 4108-1SP or equivalent by other manufacturers.
      - e. Blanks White to match plate in all unused ports
  - I. Legend:
    1. Machine printed, in the field, using adhesive-tape label.
    2. Snap-in, clear-label covers and machine-printed paper inserts.
- 2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS
- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-B.1.
  - B. Workstation Outlets: Number of ports as indicated on the drawings; connector assemblies mounted in faceplate(s) as indicated on the drawings.
    1. Faceplates: Stainless Steel (painted, brushed, or polished), brass, or high-impact plastic, to match the electrical devices in the same area. Coordinate color with Division 26 Section "Wiring Devices."
    2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
      - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
    3. Legend: Factory labeled by silk-screening or engraving for stainless steel and brass faceplates.
    4. Legend: Snap-in, clear-label covers and machine-printed paper inserts for plastic faceplates.
- 2.5 GROUNDING
- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
  - B. Comply with TIA-607.
- 2.6 IDENTIFICATION PRODUCTS
- A. Comply with TIA-606-C and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
  - B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.7 CABLE MANAGEMENT SYSTEM

- A. Description: Computer-based cable management system, in tabular form in Microsoft Excel or other file format approved by the Owner.
- B. Document physical characteristics by recording the network, TIA details, and connections between equipment and cable.
- C. Information shall be presented in spreadsheet format, schematic plans, or technical drawings.
  - 1. Microsoft Visio Professional or AutoCAD drawing software shall be used as drawing and schematic plans software.
- D. Data shall correlate and correspond to the following testing and recording devices:
  - 1. Direct upload tests from circuit testing instrument into the personal computer.

## 2.8 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA-568-B.1.
- B. Factory test UTP cables according to TIA-568-B.2.
- C. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA-568-B.3.
- D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, except in accessible ceiling spaces, in attics, where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA-569 for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.



### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. MUTOA shall not be used as a cross-connect point.
  - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
  - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  - 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 11. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
  - 12. In the communications equipment room, install a 10-foot- (3-m-) long service loop and at the "Workstation" end provide a 3-foot (1-m) service loop.
  - 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP CABLE TERMINATION PRACTICES
  - 1. Insulation Displacement Contact (IDC) connectors shall be used and installed per the manufactures' recommendations.
  - 2. Strip back only as much cable jacket as required to terminate.
  - 3. Preserve wire-pair twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
  - 4. Avoid twisting cable jacket during installation.
  - 5. Take care to ensure all data UTP wiring devices are designed for T568B wiring, T568A devices use a different pair assignment and should not be mixed.
  - 6. Data and Telephone Cable UTP T568B, Identical to AT&T 258A and WECO, Pin/Pair Assignments (All
    - 7. RJ-45 modular jacks):
      - a. Line/Pair: Color:
      - b. Rx 2 White/Orange Band
      - c. Rx 2 Orange
      - d. Tx 3 White/Green Band
      - e. Rx 1 Blue
      - f. Tx 1 White/Blue Band
      - g. Rx 3 Green
      - h. Tx 4 White/Brown Band
      - i. Rx 4 Brown
- D. UTP Cable Installation:
  - 1. Comply with TIA-568-B.2.
  - 2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- E. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
  2. Install cabling after the flooring system has been installed in raised floor areas.
  3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
  2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569 for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
  4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
  5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
  6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).
- J. COLOR-CODING
1. Provide color-coded horizontal cabling jackets, jack insert faces in wall plates, patch panels, and patch cords. Patch panels are to be separated with grouped patch panels for each designated color and use (blue only in the data patch panels, white only in the voice patch panels, etc.):
    - a. Blue Data (General use Computer Ethernet network)
    - b. White Telephone (voice, VoIP Ethernet network)
    - c. Orange Wireless Access Point
  2. Provide color-coded patch cords as follows:
    - a. Blue Data (General use Computer Ethernet network)
    - b. White Telephone (voice, VoIP Ethernet network)
    - c. Orange Wireless Access Point
- K. FIBER OPTIC SYSTEM COLOR CODING
1. A. Each type of fiber optic cabling shall feature distinctively colored labeling and jumper connectors:
    - a. Any Single Mode cabling and jumper connectors shall be Yellow.
    - b. Any Multi Mode cabling and jumper connectors shall be Aqua.
- L. CABLE RUN DESIGNATOR LABELING SCHEME
1. Each patch panel jack, wall plate jack, terminal cabinet connector, both ends of each cable run and on the ceiling grid bar at jack locations that are concealed above a drop ceiling shall be labeled with a cable scheme run designator machine printed labels installed according to EIA/TIA 606 standards. All labeling shall conform to industry standards and best practices.
  2. Labeling types and scheme shall be verified and coordinated with the Owner prior to any installation.
  3. Contractor to submit labeling scheme to Engineer and Owner for approval prior to installation.

- M. DATA/TELEPHONE CABLING PLANS
1. Provide adjacent to the equipment rack in each MDF and IDF a plan view of all building areas covered by the equipment closet meeting the following requirements:
    - a. Framed and secured to the wall and plan covered with clear acrylic panel.
    - b. Size to clearly show all required information.
    - c. "YOU ARE HERE" indicator with arrow.
    - d. Room names and numbers. Verify with Owner.
    - e. Show each device with symbol and identification address number as designated by owner.
    - f. Symbol legend.
    - g. True north arrow
    - h. Scale indicator
- N. DATA/DESK TELEPHONE STATION WALL PLATES AND JACK INSERTS
1. Provide single or multiple jack modular wall plates where shown on plans or required. The number next to symbol on plans indicates the quantity of data lines/jacks at that location, single outlets are not numbered. Where a desk telephone jack (D/#) is designated on plans the faceplate to include a telephone jack along with the data jacks. Each data or telephone jack shall be terminated and mounted in a suitable faceplate for all wall, enclosure, millwork, floor box, modular furniture, etc. locations. All terminations shall be made per the manufacturers' instructions. Jack type to match colors above. Refer to System Schedule on plan for part numbers and additional information.
  2. Use a single gang faceplate with label window for all standard wall outlets, use NEMA duplex or Decora style frames as required for floor boxes, surface raceway, etc. Refer to System Schedule on plan for part numbers and additional information.
- O. EMERGENCY SERVICE/VOICE LINES
1. Provide connectivity for emergency service/voice lines from the MDF, one line to each elevator phone and 911 emergency telephone, two lines to each alarm system digital communicator (DC).
- 3.4 FIRESTOPPING
- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
  - B. Comply with TIA-569, Annex A, "Firestopping."
  - C. Comply with BICSI TDMM, "Firestopping Systems" Article.
- 3.5 GROUNDING
- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
  - B. Comply with TIA-607.
- 3.6 IDENTIFICATION
- A. Match existing site labeling scheme.
    1. Administration Class: 4.
    2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
  - B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
  - C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
  - D. Paint and label colors for equipment identification shall comply with TIA-606-C for Class 4 level of administration, including optional identification requirements of this standard.
  - E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
  - F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA-606-C. Furnish electronic record of all drawings, in software and format selected by Owner.

- G. Cable and Wire Identification:
    - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
    - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
    - 3. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
      - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
      - b. Label each unit and field within distribution racks and frames.
    - 4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label
  - H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA-606-C.
    - 1. Cables use flexible vinyl or polyester that flex as cables are bent.
- 3.7 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
  - B. Tests and Inspections:
    - 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-B.1.
    - 2. Visually confirm specified Category marking of outlets, cover plates, outlet/connectors, and patch panels.
    - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
    - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
      - a. Test instruments shall meet or exceed applicable requirements in TIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - 5. UTP Performance Tests:
      - a. Test for each outlet and MUTOA. Perform the following tests according to TIA-568-B.1 and TIA-568-B.2:
        - 1) Wire map.
        - 2) Length (physical vs. electrical, and length requirements).
        - 3) Insertion loss.
        - 4) Near-end crosstalk (NEXT) loss.
        - 5) Power sum near-end crosstalk (PSNEXT) loss.
        - 6) Equal-level far-end crosstalk (ELFEXT).
        - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
        - 8) Return loss.
        - 9) Propagation delay.
        - 10) Delay skew.
    - 6. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA-568-B.1 and TIA-568-B.3.
    - 7. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
      - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
      - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
  - C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 27 15 00

SECTION 27 4116  
INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL NOTES

- A. Audiovisual System Designer herein shall be referred to as architect.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract including instructions to Bidders, General and Supplementary Conditions and Division 1 Specifications Sections apply to the work of this Section.
- B. ANSI-Infocomm standards (10:2013) Audiovisual Systems Performance Verification
- C. AVIXA S601.01:201X Energy Management for Audiovisual Systems (revises ANSI/INFOCOMM 4:2012)
- D. AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015) Cable Labeling for Audiovisual Systems
- E. AVIXA V201.01:201X Projected Image System Contrast Ratio (replaces 3M: 2011)
- F. AVIXA A102.01.2017 (Formerly A103.01:2017 Audio Coverage Uniformity in Listener Area
- G. ANSI/AVIXA D401.01:201X Standard Guide for Audiovisual Systems Design and Coordination Processes (replace 2M: 2010)
- H. AVIXA F502.01:201X Rack Building for Audiovisual Systems
- I. AES 67-2018
- J. 2010 ADA Standards for Accessible Design

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Power, and all conduits for both power and low voltage, shall be furnished and installed by Electrical Contractor. All back boxes to be furnished and installed by Electrical Contractor as indicated in the Schedule of Responsibility on drawing TA0.01 unless otherwise noted.
- B. Coordination with the Electrical Contractor is required to assure correct audiovisual conduit routing, audiovisual back box locations, and technical power circuit locations as specified in Division 26 – Electrical.
- C. Requirements and materials that apply to the work of others related to audiovisual systems are listed here to define and establish audiovisual system requirements. Coordinate the work of this section with the work of other sections as required in order to maintain satisfactory progress of the work of other sections. Refer to schedule of responsibility on TA0.01, UON.

1.4 WORK OF THIS SECTION

- A. This section covers all audiovisual (AV) systems as described for *Crandall ISD Performing Arts Center*. The objective is to provide professional systems, installed, acceptance tested, and ready to use.

- B. This written specification and the large format TA series drawings shall be collectively referred to herein as the Contract Documents. System features that show up in one part may not be shown in others. In the case of conflict between written specifications and drawings, Contractor must seek written clarification from the Architect. In the event the Contractor fails to obtain such written clarification, the interpretation of the Architect will prevail. Where conflict exists with other specifications concerning such work or materials, this specification takes precedence unless otherwise approved in writing by the owner.
- C. This section includes all labor, materials, equipment, and services necessary to furnish and install the Audiovisual System in Crandall ISD Performing Arts Center in Crandall, Texas as shown on the drawings, including but not limited to the following:
  - 1. System components
  - 2. “
  - 3. Etc.

#### 1.5 PROJECT CONDITIONS

- A. All dimensions and equipment locations shall be verified in the field prior to fabrication by the Audiovisual Contractor, who shall make at least one (1) visit to the job site prior to preparation of shop drawings.
- B. Coordinate conduit placement, routing, and separation with the Electrical Contractor to ensure proper installation.
- C. No claims for additional compensation shall be allowed due to the Audiovisual Contractor's misunderstanding of the work involved or lack of a thorough investigation of the job site.

#### 1.6 CONTRACTOR RESPONSIBILITY

- A. It shall be the responsibility of the Audiovisual Contractor to furnish and install equipment complete in all respects and to furnish and install any additional equipment required to fulfill the intent of the Contract Documents regardless of whether or not such items are herein specified or indicated without claim for additional payment or costs.
- B. The work specified herein shall be accomplished by a single Audiovisual Contractor who has complete responsibility for the systems described. The Audiovisual Contractor is required to have five (5) years' experience with systems of similar size and scope in professional performing arts centers.
- C. The Audiovisual Contractor shall be responsible for coordinating with other trades a complete and suitable installation of electrical isolation equipment to meet the intent of this specification.
- D. No electrical equipment (except approved equipment) shall be located within the Acoustically Sensitive Spaces or installed on walls common to Acoustically Sensitive Spaces (Refer to Part 1 Paragraph 10). The Audiovisual Contractor shall report all discrepancies between this requirement and the Contract Documents to the Architect and Electrical Engineer prior to installation of such equipment.

#### 1.7 DESIGN INTENT

- A. The Audiovisual Contractor shall furnish and install Infrastructure and Major Equipment for system including but not limited to wire, cable, equipment racks, wiring devices, and listed Major Equipment. Infrastructure, Major Equipment, and installation of Infrastructure and Major Equipment shall be bid as one portion of the project.
- B. The Audiovisual Contractor shall furnish line item pricing for Infrastructure and Major Equipment List written in this specification.

#### 1.8 FUNCTIONAL REQUIREMENTS

This report provides a narrative description of the basis of design for the audiovisual systems in the new Performing Arts Center, at Crandall High School in Crandall, Texas. The descriptions included are based on our understanding of the program as relayed to us during workshop and phone conversations with the Crandall production staff, administrative team, faculty, and design teams.

## CODE REQUIREMENTS

This document provides for preliminary design intent for all audiovisual systems within the facility. As the project continues through the design and construction process, this project will be governed by applicable local, national, and international building codes, State of Texas Building Codes, ANSI Standard, ADA Standards for Accessible Design (2010), as well as AVIXA/INFOCOMM, and AES standards for audiovisual system design & installation, including but not limited to the following:

- ANSI/INFOCOMM standards (10:2013) Audiovisual Systems Performance Verification
- AVIXA S601.01:201X Energy Management for Audiovisual Systems (revises ANSI/INFOCOMM 4:2012)
- AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015) Cable Labeling for Audiovisual Systems
- AVIXA V201.01:201X Projected Image System Contrast Ratio (replaces 3M:2011)
- AVIXA A102.01.2017 (Formerly A103.01:2017 Audio Coverage Uniformity in Listener Area
- ANSI/AVIXA D401.01:201X Standard Guide for Audiovisual Systems Design and Coordination Processes (replace 2M: 2010)
- AVIXA F502.01:201X Rack Building for Audiovisual Systems
- AES 67-2018
- Americans with Disabilities Act (ADA), 2010

## DESIGN NARRATIVE

### 1 - FACILITY WIDE SYSTEMS

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#### Isolated Power for AV systems

All audio and video systems are powered by a separate audio & video technical power system to ensure noise-free operation. The power is fed from a dedicated transformer and all associated outlets utilize isolated ground wires and hospital-grade outlets. This system is used only for audio and video equipment. The Isolated Power System also includes a 100A stage disconnect (company switch) in the Main Theater to facilitate outside events, and 30amp 3-phase receptacles for accommodate smaller scale supplemental power needs. Design of system and location of transformer to be coordinated with the electrical engineer.

#### Performance Audio/Video Network

The Performing Arts Center (PAC) shall feature an IP based audio & video transport system, allowing staff & users a flexible and efficient approach to routing media feeds, for both production and back-of-house use. The system is designed to minimize the number of physical patches necessary for efficient operation, allowing more ease of use and higher operational efficiency by the users. The system uses a series of video input and output devices that connect to dedicated AV network switches. Interconnections are made through control software, digitally connecting or disconnecting feeds from and to any performance space within the center. The AV Networks can be selectively connected to Crandall ISD Enterprise Networks, for specific streaming need, or for periodic, scheduled firmware updates to equipment.

The AV network systems consists of three (3) independent groupings of infrastructure and equipment: audio over IP primary and secondary (Dante), and control/intercom/AVoverIP. During general, day-to-day operation, all network infrastructure for audiovisual systems is isolated from other networks (enterprise, lighting, building systems, etc), however select connection to the outside world, or allowing internet access to the network can be coordinated with the enterprise networks.

- Basis of design manufacturers for sitewide equipment and digital signal processing can include:
  - DSP – QSYS
  - Networking – Netgear AV
  - Control Systems - QSYS

#### Rack Room



A rack room is included for the main AV system racks feeding the theater and FOH/BOH systems. This room is adjacent to the theater, and contains supplemental mechanical equipment to maintain a consistent, cool environment for the AV equipment. This room may also contain the Performance Lighting control racks.

#### Digital Signage

Public displays are distributed within the Public Spaces to inform, engage, and solicit visitors, as well as serve direct presentation and show-relay need for events. These displays are located in locations for subtle, yet maximum impact to students and patrons, welcoming them to, and guiding them through the events taking place in the Building.

#### Portable Equipment

Facilities for the Performing Arts contain a great deal of portable equipment for performance & educational AV use in the various spaces. Much of this equipment is quite similar in nature and operation. Portable equipment is intended to be assigned to specific areas/rooms, however the operation of the facility relies on the sharing of certain types of equipment when areas/disciplines/halls are not in simultaneous use. This is done to provide the most efficient portable equipment solution for the PAC, and limit the amount of doubling up required. Examples of the shared equipment is: microphones, portable loudspeakers, intercom belt packs, portable cables, stands, AV accessories.

## 2 – PUBLIC SPACE + ARTS INSTRUCTION LABS

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#### Lobby

Lobbies for performance spaces include monitoring capability (audio and video) to the respective performance hall, along with house manager page abilities. Video displays for digital signage, and latecomer show-relay are positioned adjacent to each performance space. Each lobby also contains an installed wireless system, allowing for simple presentations to take place within the public realm.

#### Front-of-House Support

The front-of-house support spaces have production intercom capabilities and selectable program and page feeds from the performance venues, allowing staff to monitor and communicate with backstage and stage management personnel as required. Designated front-of-house support spaces are as follows:

- Box Office & Box Office Manager's Office

#### Band and Percussion Rehearsal Rooms

The Rehearsal Rooms serve primarily as spaces for large musical group instruction and rehearsal. High-fidelity loudspeakers provide audio playback of pre-recorded material. A projector and screen are provided for instructional video presentations. Local recording capabilities are included, via ceiling mounted microphones, allowing the instructor to make quick recordings of rehearsals for immediate playback or archival purposes, as well as connect to the recording control room. Control of the AV systems is achieved via touch-panels, located on the wall, and the instructor position.

#### Scenic dock

The building dock contains loudspeakers for audio show relay of the performance space. Local volume controls are included, with a priority-page override system, allowing the stage manager announcement to be heard, regardless of the volume control position.

## 3 – PERFORMANCE SPACE

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#### Main Theater

The Main Theater of the PAC is a 800 seat proscenium/end-stage performance space with stage house, serving primarily theatre/spoken word performance and presentation style events. The hall accommodates unamplified and amplified music, as well as theatre reinforcement (for musical theater) and sound effects. Equipment and functionality included:

- Performance Audio system, providing support for audio reinforcement of music performance, and reinforcement of theatre productions and conceptual sound effects. The system consists of primary loudspeakers deployed in an “Left/Center/Right” arrangement, hanging from the proscenium reflector. Supplemental loudspeakers are provided to extend the frequency response of the primary speakers, or as fill loudspeakers for imaging purposes. Surround loudspeakers within the hall are to be replaced, and assigned for patching purposes. Facilities production panels are located throughout the stage allowing connection of equipment to the system, including microphones and other input devices, stage monitors, and specialty network devices. Facilities production panels are also added to locations currently without connectivity. Control is achieved from a digital mixing console (with Dante backbone) located at the existing mix position at the rear of the audience chamber. Basis of design manufacturers can include:
  - Loudspeakers – d&b audiotechnic A-Series constant-curve line-source array; d&b subwoofers, front-fills, and delay loudspeakers.
  - Amplifiers – d&b audiotechnic for performance loudspeakers; QSC for patching amps
  - Digital Mixing System – Allen & Heath Avantis series
- Performance Video Projection System – A motorized roll-down projection screen and video projector shall be provided for presentation use. To accommodate the flexible video deployment as required per production or event, connection points for coaxial and category cable (AVoverIP) video are provided throughout the space, with specific connectivity for presentation positions from the stage. Basis of design manufacturers can include:
  - Projector – Barco or Christie – WUXGA or 4K.
  - Screen – Draper
- Support Systems –
  - Assistive listening systems, which transmits the acoustic stage (via room microphone) or console feed sound over a radio frequency to receivers used by the hearing impaired, is included. Alternative use of the system is to broadcast additional languages, or provide audio description for the sight impaired and shall include a two-channel system for this reason. Basis of design – Listen Technologies or Williams Sound
  - Production Intercom - 2-channels of analog, party-line style intercom are provided for this room (Clear-Com).
  - Video/Audio Show Relay – a fixed PTZ camera and room microphone are installed to provide show relay to front-of-house and back-of-house support spaces.
  - Stage Management Systems – a portable stage manager station consisting of two portable rack cases is included, for flexible, ADA compliant deployment to designated areas backstage, in control rooms, or within the house for tech rehearsal purposes. The stage manager station includes an intercom remote station and microphone for back-of-house paging. Additionally, a touchpanel in the station allows control over camera feeds and chimes, and show-relay mutes. The second rack case includes dual displays, allowing the stage manager to view the color PTZ camera view and an additional source.
- Loose Equipment – Wired microphones, DI boxes, cables, stands, portable loudspeakers and monitor wedges appropriate to the program are provided.

#### Dressing Rooms

The Dressing/Changing rooms and production support spaces are intended as support spaces for the main theater. These rooms shall contain loudspeakers for audio show relay of the performance space. Local volume controls are included, with a priority-page override system, allowing the stage manager announcement to be heard, regardless of the volume control position.

Basis of Design – Show Relay Loudspeakers – QSYS or JBL

### 1.9 SCOPE OF WORK

- A. Furnish shop drawings and receive approval, prior to fabrication and installation.
- B. Furnish all materials and labor and any engineering services to supply a complete and professionally installed system in working order as described herein. Labor furnished shall be specialized and experienced in audiovisual system installation.
- C. Furnish and install all wire and cable called out in the Contract Documents.
- D. Coordinate all back box locations with the Electrical Contractor and appropriate general trades.

- E. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include but are not limited to hardware, transformers, line/distribution amplifiers and other devices for proper installation, interface, isolation, or gain structure.
- F. Perform initial adjustments and verification tests. Submit verification test report to the Architect five days prior to commissioning.
- G. Participate in acceptance testing and perform final adjustments utilizing Audiovisual contractor furnished test equipment and project engineers.
- H. Furnish and participate in user training.
- I. Furnish system documentation including copies of all relevant drawings and equipment manuals in compliance with the Contract Documents.
- J. Furnish maintenance services for the specified period from the date of acceptance.
- K. Guarantee all new equipment, software, hardware, components, and workmanship for the specified period from the date of acceptance.
- L. Refer to drawing TA0.01 Audiovisual General Notes for the Schedule of Responsibility.

#### 1.10 SUBMITTALS

- A. Pre-bid Submittals:
  - 1. Contractors must pre-qualify in order to bid on this project. Contractors must provide proof of the following qualifications and certifications and evidence of experience in similar audio and/or video installations. Submit listed qualifications to Architect for review ten (10) days prior to submission of a bid. Late submittal will result in exclusion from bid.
    - a. Credential for project manager, project engineer, and lead installer which must include NICET, EST, and/or CTS-I certifications.
    - b. Proof of the AV Contractor's membership in NSCA or AVIXA (Audiovisual and Integrated Experience Association). Indicate current AVSP level.
    - c. Proof that the AV Contractor has been continuously engaged in the installation and service of AV equipment for at least five (5) years in systems of similar size, scope, and project type.
    - d. Proof that the AV Contractor holds current certifications necessary to perform Graphic User Interface Programming and Configuration.
  - 2. The following AV Contractor have been pre-qualified to bid on this project:
    - a. Electro Acoustic  
685 John B. Sias Memorial Parkway, Ste. 705  
Fort Worth, TX 76134  
(817) 924-2756  
Contact: Luke Jordan  
ljordan@eavi.com
    - b. Professional Audio Designs  
11629 W Dearbourn Avenue  
Wauwatosa, WI 53226  
(414) 476-1011  
Contact: Kim Leonard  
kim@proaudiodesigns.com
    - c. Solotech  
1717 Diplomacy Row  
Orlando, FL 32809  
(702) 614-8882  
Contact: Aaron Beck  
Aaron.beck@solotech.com
    - d. Clair Global Integration  
3327 Ambrose Avenue

Nashville, TN 37207  
(717) 626-4000  
Contact: Joe Bunting / Phillip DiPaula  
jbunting@clairglobal.com  
pdipaula@clairglobal.com

B. Bid Submittals:

1. Contractors shall examine all drawings and read all divisions of this specification in order to avoid omissions and duplications and to ensure a complete job. No allowances shall be made for failure to read and understand the Contract Documents. Discrepancies between drawings and the specifications or obvious omissions shall be referred to the Architect prior to the bid date. Where discrepancies occur and pre-bid instructions have not been obtained, the Contractor agrees to abide by the Architect's decisions.
2. Bid proposals shall include all work and all equipment as specified, as well as any additional equipment and materials not listed here, to be used in assembling the system to fulfill the design intent.
3. The bid submittal shall include the following:
  - a. Infrastructure and Major Equipment List and installation bid.
  - b. Major Equipment List line item pricing.
    - 1) Installation costs for General Equipment including hardware and labor shall be furnished.
    - 2) Pricing shall include in-bound freight, shipping, and all delivery charges.

C. Shop Drawings Submittals:

1. Within thirty (30) days of contract award, submit four (4) copies of detailed shop drawings to the Architect for approval. All shop drawings shall be marked with the related drawing number when submitted.
2. System installation and fabrication shall not begin without written approval from the Architect.
3. Review of shop drawings shall not constitute final approval of system function. Said review does not in any way relieve the Contractor from the responsibility of furnishing material or performing work as required by the Contract Documents.
4. Failure of the Contractor to submit shop drawings in ample time for the evaluation shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default will be allowed.
5. At a minimum, shop drawings shall include:
  - a. Table of Contents
  - b. Itemized list of all equipment and materials to be used in assembling the system.
  - c. Catalog cut sheet or data sheet for each listed item.
  - d. One-line Signal Flow diagrams for all sound reinforcement systems, visual systems, and auxiliary systems showing point to point wiring interconnections of all equipment with wire run numbers and patch bay designations. Show all transformers, switches, relays, control circuits, and modifications to equipment. Show all equipment items which are required for realization of the functions described herein.
  - e. Complete lists of all wire run numbers along with the termination location of each end of each wire run.
  - f. Schematic diagrams for any custom circuitry and all typical connections between audio lines, patch bays, visual system lines and rack mounted equipment.
  - g. Drawings of all items which are to be custom fabricated or modified. Drawing shall be in scale suitable for fabrication. They shall show materials, finishes, hardware, back boxes, connectors, and panel/control markings. Submit samples of lettering/label size and typeface to be employed on custom plates, panels, and other equipment.
  - h. Submit samples of custom work, finishes, or other materials as required by the Architect to verify appearance and quality. All costs for shipping samples shall be the responsibility of the Contractor.
  - i. Full size drawings illustrating the physical layout and labeling of patch bays.
  - j. Mechanical drawings of all assemblies, major and sub-assemblies, racks, cabinets, and enclosures, indicating provisions for proper cable management, power management, and thermal management.

- k. Mechanical drawings showing all proposed mounting details of all major equipment (e.g. loudspeakers, cameras, projectors, video displays, projection screens), and associated rigging and interface with adjacent architecture.
  - l. Vibration and noise control information shall be included and coordinated with the Electrical Contractor.
  - m. Conduit Routing Plan, to be coordinated with electrical contractor prior to cable pull.
  - n. Cabling schedule providing information as detailed in AVIXA (formerly known as Infocomm) Standard F501.01:2015 to be coordinated with the Architect and Owner prior to cable pull and termination.
6. The above listed drawings shall be produced on AutoCAD 2004 min. or similar computer drafting program. Scans or photocopies of the Contract Documents are not acceptable.
  7. The use of electronic files from other sources (e.g. Architect's backgrounds, Architect's drawings, vendor-supplied panel drawings) shall not absolve the Contractor of the responsibility for ensuring that the Shop Drawings represent a completely engineered coordinated system. The Contractor has final responsibility for providing systems that conform to all requirements in the Contract Documents.
  8. The Contractor shall review Electrical Contractor shop drawings for all vibration and noise control equipment and systems information.
  9. Proposed Touch Panel Graphical User Interface (GUI) layouts shall be submitted for approval prior to the commencement of control system programming.
- D. Substitutions:
1. Substitutions shall be submitted as per the General Conditions of the Contract Documents.
  2. The proposed substitutes must be equivalent or superior to the specified products in quality, performance, construction, function, conformance to system objectives and not affect system functionality, signal type, distribution, and features.
  3. All substitutions must receive the express written consent of the Architect and Owner.
  4. The Architect reserves the right to substitute new products which become available subsequent to the issuance of the Contract Documents, provided that:
    - a. The contractor has not yet purchased the originally specified equipment.
    - b. The substitute equipment shall not materially increase the Contractor's cost.

#### 1.11 JOB CONDITIONS

- A. Keep the job adequately staffed at all times. Unless illness, loss of personnel, or other circumstances beyond the control of the Contractor intervene, keep the same individual charge throughout.
- B. Cooperate with all appropriate parties in order to achieve well-coordinated progress with overall construction completion schedule and satisfactory results.
- C. Watch for conflicts with work of other contractors on the job and execute, without fair claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or to preserve acoustic or visual performance, symmetry, and pleasing appearance.
- D. Immediately report to the Architect any design or installation irregularities, particularly architectural elements that interfere with the intended coverage angles of loudspeakers, camera, or projection equipment, so that appropriate action may be taken.
- E. Perform any and all cutting, patching, and painting for proper and finished installation of the system and repair any damage done as a result of such installation.
- F. Audiovisual System work areas are to be maintained in a clean and orderly condition. Clean up and dispose of trash from all audiovisual system work areas.

#### 1.12 ACOUSTICALLY SENSITIVE SPACES

- A. The following areas have been designated as "Acoustically Sensitive Spaces":
  1. Control Rooms
  2. Amplifier Rack Rooms
  3. Electrical Equipment Spaces

4. Mechanical Equipment Spaces

- B. An acoustically sensitive space is defined as a room or space, which requires special construction consideration to meet room acoustic, acoustic isolation, and noise control or vibration control requirements.
- C. All conduit runs penetrating acoustically sensitive spaces shall have both ends sealed by means of removable closed cell neoprene foam after all cables have been run to prevent sound transmission from adjacent spaces.
- D. All audiovisual wiring devices in acoustically sensitive spaces shall have a gasket sealing the faceplate to the back box to prevent sound transmission from adjacent spaces.

1.13 DELIVERY AND HANDLING

- A. The Audiovisual Contractor shall coordinate delivery and installation of all equipment with the Construction Manager and/or Electrical Contractor.
- B. If required by the Construction Manager or Electrical Contractor, audiovisual equipment shall be delivered in a minimum of three (3) separate shipments that shall include:
  - 1. Shipment #1: All items in which conduit is terminated which includes back boxes, wiring device faceplates with receptacles, projection screen cases, etc.
  - 2. Shipment #2: All items which require structural backing such as rigging components, monitor and projector mounts, etc.
  - 3. Shipment #3: All items that are not required until the building/area of work is secure and ready for electronic equipment. This shall include equipment racks, wiring device face plates, portable equipment, etc.
- C. Audiovisual Contractor shall deliver all material to the job site suitably crated, packed, and protected and bearing the label and the nomenclature of the product(s) found in each carton or crate.

1.14 QUALITY ASSURANCE

- A. Parts listed shall be complete and equipment furnished shall conform to manufacturer's specifications.
- B. All materials shall be new and shall conform to the applicable provisions of Underwriter's Laboratories (ULEQ) and American Standards Association (ASA).
- C. Procure and pay for all permits, licenses, and inspections, and observe any requirements stipulated therein. Conform in all trades with all local regulations and codes.
- D. Comply with federal, state, and local labor regulations and applicable union regulations.
- E. Installation shall conform to the latest federal, state, and local electrical safety codes of authorities having jurisdiction. Where conflict exists, the most stringent code or regulation shall apply.

1.15 GUARANTEE AND SERVICE

- A. The Audiovisual system shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practice.
- B. All new systems and components shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.
- C. Installation of relocated existing equipment shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.

- D. All audiovisual system software updates shall be automatically issued to the Owner free of charge during the warranty period.
- E. The Contractor shall be available on call and on eight (8) hour notice during the first month following acceptance of the system, to assist the Owner's representatives in any problems which may arise during the initial period of operation.
- F. The Contractor shall provide same day response to service requests, via 24/7 phone support.
- G. If during guarantee period any component is out of service for more than seven (7) consecutive days due to unavailability of parts or service, the contractor shall furnish and install identical new component. If an identical component is not available, the contractor will substitute equivalent equipment with written approval of the owner.
- H. During the course of the guarantee period, the Contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment and programming. Contractor shall submit proposed schedule for these visits and shall notify Owner and Architect in writing at least one (1) month in advance of each visit.

#### 1.16 INSURANCE

- A. All equipment and materials shall be fully insured against loss or damage up until acceptance of the system by the Owner or until the Owner relieves the Contractor in writing of this responsibility, whichever is earlier.

### PART 2 - EQUIPMENT

#### 2.1 GENERAL

- A. Whenever any equipment is specified by manufacturer and model number, it is for the purposes of establishing a standard of quality, performance, construction, and function.
- B. All materials and equipment shall be new and of the latest design or model offered for sale by the manufacturer.
- C. Equipment models furnished shall operate at the required AC line voltage (i.e. 120 Volts) and frequency (i.e. 60 Hz)
- D. Contractor shall furnish at minimum, quantities as indicated in the Contract Documents as required for complete installation.
- E. Audiovisual Wire and Cable:
  - 1. Approved manufacturers:
    - a. Belden
    - b. Berk-Tek
    - c. Liberty
    - d. Crestron
    - e. Extron
    - f. West-Penn
  - 2. All wire numbers listed in the Contract Documents are Belden unless otherwise noted.
  - 3. Where required, install plenum rated cable listed and labeled for plenum installation.
- F. Electrical Wire and Cable (including ground conductors)
  - 1. Where conflict exists with any codes or ordinances, such codes and ordinances shall take precedence.
  - 2. Where conflict exists with Electrical Specifications, the higher standard or more stringent requirement shall apply.

- G. Wiring Devices:
1. Specifications – Duplex Receptacles
    - a. Grade: Specification, Hubbel IG5362 or equal
    - b. Type: NEMA 5-20R
    - c. Color: Orange
  2. Specifications – Plug Mold
    - a. Grade: Wiremold V/G 2000 Series or equal
    - b. Size: As specified or required.
  3. Specifications – Outlet Strips
    - a. Grade: UL Listed, Wiremold or equal.
    - b. Size: As specified or required.
  4. Approved Manufacturers:
    - a. Waber
    - b. Wiremold
    - c. Hubbell
    - d. Bryant
    - e. GE
    - f. Leviton
- H. Electrical Plates and Panels:
1. Specifications – Rack mount panels
    - a. Material: 11-gauge steel or 1/8" aluminum, minimum thickness.
    - b. Finish: Black or to match adjacent equipment.
    - c. Size: 19" wide, standard EIA mounting hole spacing, height as specified or required.
  2. Specifications – Back Box Enclosures
    - a. Material: Code grade steel.
    - b. Finish: Black or Galvanized.
    - c. Size: As specified or required.
  3. Specifications – Plug Box and Termination Panels
    - a. Material: 11-gauge steel or 1/8" aluminum, minimum thickness.
    - b. Finish: Black (unless otherwise noted by the Architect).
  4. Any and all recessed face plates shall have a minimum 3/4" reveal beyond the back box to hide the intersection between the wall material and the back box excluding standard decora-style plates.
  5. Approved Manufacturers:
    - a. Hoffman
    - b. Whirlwind
    - c. Pro-Co
    - d. Wireworks.
- I. Any equipment to be located outdoors or in damp locations must carry a NEMA 3R rating and be labeled accordingly.
- J. Audio Transformers:
1. All transformers shall be selected for proper installation and load of the circuits as required by as-built conditions and per manufacturer's recommendations.
- K. Control System Programming:
1. All control system programming, installation, testing, and debugging to be performed by a manufacturer certified programmer, supplied either directly by the AV Contractor staff or via a manufacturer authorized and certified independent programmer.
  2. AV Contractor shall furnish complete control system programming, including all source code and on-site coordination, testing, and debugging.
  3. AV Contractor shall furnish all programming of control system equipment including:
    - a. Nightly system shut down.
    - b. Janitorial/Off-hour maintenance control.
    - c. Emergency Life/Safety override.
    - d. TBD
  4. In rooms where a volume control system and digital signal processor (DSP) exist, the control system shall be programmed such that:



- a. The appropriate preset on the DSP system and display system shall be selected based on that activity taking place.
    5. Provisions for control from a computer via web interface (e.g. XPanel) shall be included.
    6. Control system programming shall accommodate future addition of touch panels and mobile applications (e.g. Crestron Mobile Pro) for Apple iPhone/iPad and Android devices.
    7. AV Contractor to schedule meeting with owner and Architect to review control system functionality and operational requirements prior to the commencement of work.
  - L. Intelligent Building Technology (IBT) Integration:
    1. Coordinate with the Building Automation System (BAS) programmer to gather the appropriate protocols, addressing, and systems.
    2. Coordinate with the manufacturer of the IBT system to obtain proper configuration of IBT equipment and components.
    3. Create a dashboard for display of building energy management information including these components at minimum:
      - a. xxx
  - M. Audio DSP System:
    1. Audio Inputs
      - a. All system audio inputs shall be programmed with limiters.
      - b. It shall be possible to matrix any input to any output within the system.
    2. Audio Outputs:
      - a. All audio outputs shall be programmed with high pass filters, parametric equalization, delay, and limiters.
      - b. It shall be possible to matrix any input to any output within the system.
    3. Assistive Listening or Hearing Assistance System (HA):
      - a. HA shall receive the same signal as being heard via the loudspeakers.
      - b. HA shall be set up in accordance with ADA requirements.
    4. The DSP software shall be installed on the digital audio work station (DAW) specified in the Major Equipment List.
  - N. Equipment furnished shall be that specified herein.
  - O. Detailed performance specifications shall be those published by the manufacture effective on the date of this document for all equipment specified herein.
  - P. The AV Contractor shall verify all projection screen dimensions, surface type, and frame style with the Contract Documents and submit the information with the required shop drawings for approval by the architect prior to ordering any material. Failure to coordinate screen information shall not result in additional costs to the Owner.
  - Q. The AV Contractor shall verify all projector lenses for appropriate focal length and intended image size with the Contract Documents, based on field measurements of actual throw distance. Failure to coordinate lens information shall not result in additional costs to the Owner.
  - R. All miscellaneous materials including brackets, pole extensions, mounting hardware, electrical connectors, and other items to properly install the equipment specified shall be included as part of this project whether it is listed or not.
  - S. Existing structural mounting to be reused as conditions permit.
  - T. If required, Cost Reduction and/or Value Engineering shall be conducted by the Architect and Owner based on final bid amounts.
- 2.2 MAJOR EQUIPMENT
- A. Vendor Quotes:

1. Contractor shall be responsible to coordinate with owner to verify manufacturer financial program is appropriate in regards to equipment for this project, as well as the associated soft costs and miscellaneous hardware and cabling costs. The following Vendor Quotes are included on this project:
- B. Major Equipment List:
  1. The major equipment list itemizes system components and their quantities to provide the systems as shown in the contract documents. It is the responsibility of the contractor to provide any additional accessories, patch cabling, interfaces, and other miscellaneous equipment not described herein to provide a working system as called out in the functional requirements section of this specification (1.7), unless otherwise noted as owner furnished or future equipment. For items not given specific quantities in these documents, it is the responsibility of the contractor to verify those quantities with the owner and architect prior to system installation.
  2. Refer to Attachment 27 41 16 Schedule A for the Major Equipment List

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF SYSTEMS

- A. Locate all apparatus requiring adjustments, cleaning, or similar attention so that it will be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.
- B. Furnish and install brackets, braces, and supports. Minimum fastening or support safety factor shall be at least five (5). Design shall be approved by the Architect.
- C. All supporting structures supplied by the Contractor not having standard factory paint finish shall be painted. Paint specifications shall be supplied by the architect or indicated herein.
- D. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect. This does not exclude equipment or materials where standard colors or finishes may be specified herein.
- E. Finish of blank panels and custom assembly panels shall match adjacent equipment panels.
- F. Switches, connectors, jacks, receptacles, outlets, cables, and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched, or screened. Markings for these items are detailed in the contract documents to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Architect prior to marking.
- G. The equipment specified herein is designed to operate in environments of normal humidity, dust, and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.
- H. Coordinate with millwork fabricator for installation of audiovisual equipment into credenzas, lecterns, etcetera.
- I. Review and coordinate Graphic User Interface Control System appearance and functionality:
  1. Crestron DigitalMedia© System: The DigitalMedia© systems shall be installed, configured, and tested by a DMC-E certified technician and/or engineer, in accordance with the guidelines set forth in the Crestron HD-DTDS Specification.
  2. AMX AV Control System: AV Control system shall be installed, configured, and tested by an ACE-P certified technician and/or engineer, in accordance with the guidelines set forth in the AMX Solutions Master program. The Resource Management Suite shall be installed, configured and tested by a ACE-RMS certified technician and/or engineer, in accordance with the guidelines set forth in the AMX Solutions Master program.

3. Extron Certified Associate professional license for basic Extron Systems. An Extron Control Professional Certification shall be required for Graphic User Interface (GUI) requiring customized GUI Design.

### 3.2 CONDUIT

- A. Review and coordinate audio installation with the Electrical Contractor to ensure proper operation of the audio system.
- B. All wiring shall be in conduit unless authorized by the Architect, approved by the Architect in writing, and permitted by code. Exceptions are short runs at equipment terminations where there is no means of connecting conduit to the equipment.
- C. Where installed exposed, conduits shall be parallel with or at right angles to walls or ceiling and /or follow surface contours and shall be supported from walls or ceilings by means of approved clamps or hangers. Conduit connections to equipment racks shall be insulated.
- D. Minimum size conduit shall be trade size  $\frac{3}{4}$ ". All conduits shall be sized for maximum 40% fill or less if required by code.
- E. Conduits carrying high voltage or high amperage wiring serving equipment subject to abrupt start-up and possible slapping of wiring within conduit shall not pass through Acoustically Sensitive Spaces.
- F. Conduits connected to dimmer racks or to transformers shall not pass directly into Acoustically Sensitive Spaces. Conduits connected to dimmer racks or transformers shall not penetrate walls, floors, or slabs of Acoustically Sensitive Spaces within thirty (30) feet of those equipment room walls or slabs. All penetrations in the path of conduits within thirty (30) feet of electrical rooms containing dimmer racks or transformers shall be resilient penetrations.
- G. Large numbers of conduits penetrating walls of Acoustically Sensitive Spaces shall be individually sleeved and shall pass through walls, floors, slabs, and ceilings perpendicularly.
- H. Conduits shall not be installed to connect or contact rigidly other non-electrical equipment or building systems which are vibration isolated.
- I. Coordinate all conduit sizes, locations, and quantities with the Electrical Contractor to provide proper routing, signal separation, and wire group type. Failure to do so shall not allow for additional compensation. Provide a conduit routing plan for approval by the Architect prior to installation. Routing plan shall include intended sizes, separation, and cable fill chart.
- J. Existing conduit and cabling infrastructure to be reused is to be done so to the maximum extent possible without compromising audiovisual system performance.

### 3.3 RESILIENT PENETRATIONS OF WALLS AND SLABS

- A. All conduit and cable penetrations shall be sleeved, packed, and caulked airtight to form a resilient penetration at the following locations:
  1. Mechanical Equipment Rooms
  2. Electrical and Dimmer Equipment Rooms
  3. Acoustically Sensitive Spaces
  4. Rooms with Acoustically Isolated Construction.
- B. Openings shall be oversized and sleeved to provide an inner diameter of one (1) to two (2) inches greater than the outside diameter of the duct or pipe. The conduit shall be centered in the opening and shall not rigidly contact the wall, floor, or ceiling. The resulting gap shall be packed with glass fiber packing material and foam rod. The gap shall be caulked to an airtight seal using permanently flexile acoustical sealant.

- C. Acoustical sleeves may be used in lieu of resilient penetrations described above. Multiple conduit penetrations may be constructed following the detail for multiple penetrations identified in the Contract Documents.

### 3.4 ELECTRICAL POWER

- A. Review and coordinate electrical power system installation including grounding with the Electrical Contractor to ensure proper operation of the audiovisual system.
- B. Verify that All AC power circuits designated for audio equipment are wired with the correct polarity and ground. Report in writing any discrepancies found to the Architect for corrective action.
  - 1. Provide distribution of electrical power within the equipment racks with a minimum of one space AC receptacle for each four (4) in use per branch circuit.
  - 2. The Electrical Contractor shall ensure that all audio grounding does not intersect with any building ground except at earth.

### 3.5 STEEL SUPPORTS

- A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, shall be permitted except as authorized in writing by the Architect.

### 3.6 SEISMIC RESTRAINTS

- A. All hanging or free-standing equipment and cabinets furnished, including but not limited to racks, loudspeakers, projection screens, and mounts shall be secured to substantial building structures. The equipment described herein shall resist seismic acceleration in any direction up to a limit of the greater of 1.0G or the limit prescribed by the local governing codes.
- B. Loudspeaker hanging details, rack bracing, and other seismic restraints may not be shown on the Contract Documents. The Contractor is responsible for development of these drawings to be submitted and approved by the Structural Engineer.

### 3.7 BOXES

- A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment, and wiring shall be held in place and the mounting shall be plumb and square.
- B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.
- C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized in writing by the Architect.
- D. Clean all box interiors prior to installing plates, panels, or covers.

### 3.8 WIRING METHODS AND PRACTICES

- A. Furnish and install all audiovisual wire and cable ensuring proper pulling tension, bend radius, quantities, types, lengths, routing, wire group separation, and identification.
- B. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten (10) percent of those in actual use or one, whichever is greater
- C. Splicing of cables is not permitted between terminations of specified equipment.

- D. Do not pull wire or cable through any box fitting or enclosures where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion, or damaging bending during installation.
- E. Use wire pulling lubricants and pulling tensions in accordance with the wire and cable manufacturer's recommendations.
- F. All wires shall be permanently identified at each wire end by marking with adhesive on crimp-on markers and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.
- G. Wire ends shall be wrapped with appropriate heat shrink tubing. Each shield or drain wire shall be covered with heat shrink to avoid unintentional connections.
- H. Use ring or tongue lugs on all barrier strip terminals. Do not exceed two (2) lugs per terminal. Use crimping tools that are designed for the application or solder. Do not cut strands from conductors to fit lug terminals. Spare terminal blocks, equivalent to ten percent (10%) of those in actual use shall be furnished.
- I. Form in an orderly manner all conductors in enclosures and boxes, wire ways, and wiring troughs, furnishing circuit and conductor identification. Tie using tie wraps of appropriate size and type. Limit spacing between ties to twelve (12) inches and furnish and install circuit and conductor identification at least once in each enclosure.
- J. When the audiovisual cables are pulled, leave a five-foot (5') tail at each end to all field locations and a fifteen-foot (15') tail at all equipment rack locations. Temporary labels shall be applied at both ends of each cable. Permanent labels shall be applied when the cables are cut back and terminated.
- K. All labeling of audiovisual cables shall comply with AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015) Cable Labeling for Audiovisual Systems Standard.
- L. . The numbering system used in compliance with this standard shall be verified with the owner prior to implementation. A schedule of all cabling and its labels shall be provided to the owner and Architect for review prior to pulling and termination of cables.

### 3.9 GROUNDING

- A. Audiovisual system wiring shall conform to the following procedures:
  - 1. Audio equipment AC ground pins shall connect to AC ground.
  - 2. Audio equipment chassis shall connect to rack frames.
  - 3. Audio rack frames shall connect to AC ground bus in panel board by means of #2 gauge (minimum) conductor
  - 4. Audio shields between AC powered pieces of equipment shall be connected to ground at one end only. Terminate capacitance as required.
  - 5. Audio signal paths between AC powered pieces of equipment shall be connected using balanced lines and/or transformer isolation as required.
  - 6. No unbalanced signal paths may be connected to patch bays.
  - 7. Isolate all audiovisual system wiring from racks, back boxes, and conduit.
  - 8. Isolate all audiovisual system racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring.
  - 9. AC isolated ground system shall be isolated from all other facility grounds.
- B. All metallic conduit, boxes, and enclosures shall be grounded in accordance with the current National Electric Code (NEC).
- C. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provisions of grounding conductors separate from AC ground.

### 3.10 EQUIPMENT RACKS

- A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired, and tested in the Contractor's shop. Final assembly of racks shall take place on site after transportation but will conform to the same test results achieved in the shop.
- B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. The insertion of additional equipment not indicated herein or any changes of placement of the equipment must be indicated in writing to the architect before assembly.
- C. Racks shall be installed plumb and square without twists in the frame or variations in level between adjacent racks.
- D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.
- E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.
- F. All field termination shall enter the rack via a bulkhead panel(s) mounted to the rear-rails of the equipment rack.
- G. All wires and cable used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.
- H. Harnessed cables shall be combed straight, tie wrapped every eight (8) to twelve (12) inches, and attached to the structure as necessary. Each cable that breaks out from the harness for a termination shall be provided with ample service loop to permit equipment removal from the racks without disconnecting.
- I. Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment, controls components, or terminations.
- J. Cables shields shall be connected to the isolated ground system with due regard for the ground loops.
- K. All system components and related wiring shall be located with due regard from the minimization of induced electromagnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience of the operator.
- L. All rack mounted equipment with front panel controls, shall be furnished with security covers to avoid tampering with preset levels. If specific security covers are not included in the equipment list, the Contractor will furnish the manufacturers suitable alternate.
- M. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire audio chain.

### 3.11 INITIAL ADJUSTMENT

- A. Verify all circuits and extensions for correct connection, continuity, and polarity. Absolute polarity shall be maintained between all points in the system.
- B. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. Verify that polarity connections are consistent throughout the system.
- C. Verify that the audio system is operational and the system gain structure is within the recommendations of major component manufacturers.

- D. Verify that the all video sources (cameras, players, etc.) and that all video destinations (Projectors, displays, recorders, etc.) are sending and receiving video signals. EDID parameters for all digital video devices shall be reviewed with the owner to verify resolution requirements at all video output devices. Confirm all equipment managed by the audiovisual control system can receive and send control signal as applicable, and that all control parameters and functionality as requested by the owner in the meeting prior to the beginning of work identified in section 2.1.K.9 of this specification have been implemented.

### 3.12 VERIFICATION TESTS

- A. Confirm that each individual wire and cable run has been labeled and documented in compliance with AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015).
- B. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. Contractor shall furnish a wide band oscilloscope in order to verify this condition.
- C. Confirm that the system is free of audible clicks, pops, hums, and other noises when any operating control is activated, with or without an input signal
- D. For all audio and video lines, confirm:
  - 1. Proper circuits appear at each termination location.
  - 2. Proper circuits appear at each jack bay location.
  - 3. Continuity of all conductors.
  - 4. Proper polarity is maintained.
  - 5. Absence of shorts between conductors within each circuit.
  - 6. Absence of shorts between circuit conductors and conduit.
- E. Confirm that the loudspeakers and mountings are free of buzzes and rattles when the speaker is swept with sine wave tones over its rated bandwidth at one-half (1/2) its maximum rated power.
- F. For all permanently mounted loudspeaker terminations, furnish impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented in a table listing impedance for each third octave from 20 Hz to 20 kHz and shall be accurate to the nearest 0.1Ω.
- G. For each installed data network cable or fiber optic cable, verify that performance conforms to the relevant TIA/EIA specifications.
- H. For all electronic devices mounted in racks and connected to patch bays confirm:
  - 1. Every audio input and output is balanced.
  - 2. Proper polarity is maintained throughout the entire audio signal path.
- I. Confirm that there are no short circuits between the neutral and isolated ground conductors for each clean power circuit.
- J. Confirm every input and output for video system including:
  - 1. Proper signal to displays.
  - 2. Proper sync to playback and recording equipment.

### 3.13 VERIFICATION TEST REPORT

- A. Submit five (5) copies of a written report detailing the results of Initial Adjustments and Verification Test including all relevant drawings, charts, test instrument data and photographs. This report shall be completed and submitted to the Architect for review a minimum of five (5) days prior to Acceptance Testing and final tuning. With this report, submit written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection, testing, and tuning.

### 3.14 ACCEPTANCE TESTING

- A. Acceptance Testing shall be performed by the Architect during a period designated by the Architect. Contractor shall furnish a minimum of two (2) technicians for the acceptance testing period.
- B. All systems shall be compliant with AVIXA ( standard 1M:2009 Uniform Distributed Audio Standard as applicable.
- C. The minimum time required for Acceptance Testing is two (2) working days of dedicated quiet. Coordinate this time period so that free access, work lighting, and electrical power are available on site.
- D. The AV Contractor shall bear any costs incurred for additional Architect's time and expenses due to failure to have the system functioning in accordance with specification requirements at the time scheduled for Architect's Acceptance Testing and Tuning.
- E. Ensure that audiovisual areas are in a clean and orderly condition ready for Acceptance Testing.
- F. At the time of Acceptance Testing, submit one (1) copy of the operation and maintenance manual to the Architect (refer to Paragraph 3.15).
- G. Furnish test equipment meeting the following minimum specifications on site, at all times during the Acceptance Testing. Prior to Acceptance Testing, provide the Architect with a listing of the equipment model numbers and their software versions (if applicable) to be made available.
  - 1. Oscilloscope: 1GHz bandwidth sensitivity – 1mV/cm
  - 2. Digital Multi-meter: 1% accuracy
  - 3. Function Generator: 1GHz bandwidth, distortion <1%
  - 4. Real Time Analyzer: 1/3 octave with microphone.
  - 5. Pink Noise Source: 20 Hz – 20 kHz
  - 6. Impedance Sweep Meter: 20 Hz – 1 kHz range, 1 $\Omega$  - 50 $\Omega$ .
  - 7. Polarity Checker: Microphone level, Line Level, and Loudspeaker Level.
  - 8. NTSC bar graphs and other test patterns for video verification.
  - 9. Ultra High definition (4K60) Video test generator with VGA, DVI, HDMI 2.0, SDI, and 3G-HDSI outputs
- H. Be prepared to verify the performance of any portion of the system by demonstrations, listening, and viewing tests, and instrumented measurements.
- I. Make additional mechanical and electrical adjustments within the scope of the work which may be deemed necessary by the Architect as a result of the Acceptance Test. This may include realigning and re-aiming of video or audio systems, changes in system gain structures, grounding, filtering, or interfaces.
- J. Final acceptance will be contingent upon issuance by the Architect of a letter of acceptance stating that the work has been completed and is in accordance with the Contract Documents. The warranty period will begin upon issuance of said letter.

### 3.15 SYSTEM DOCUMENTATION

- A. Within fifteen (15) days of the Acceptance Testing, prepare and submit five (5) neatly bound copies of the operations and maintenance manuals to the Owner. Manuals shall be placed in an orderly fashion into a three-ring binder with spine labels indicating contents. These copies are in addition to the one (1) copy furnished to the Architect during Acceptance Testing.
- B. Manual shall include but not be limited to the following:
  - 1. Table of contents
  - 2. Written Guarantee and Service Policy
  - 3. Basic power on/off and operational procedures.
  - 4. All Available manufacturer's operation and service literature for each major system component
  - 5. A one-line signal flow diagram with all cable runs and patch points identified by alphanumeric characters



6. A copy of the Verification Test Report
  7. Two (2) copies of as-built conduit riser diagram obtained from the Electrical Contractor
  8. A copy of the final tuning settings as furnished by the Architect
  9. Electronic versions of all documents included in the manual and electronic back up of all software, firmware, and files to restore initial install presets for all applicable devices copied on to (2) USB storage devices.
- C. Furnish a framed copy of the as-built signal flow diagram to be mounted in the **TBD**. This diagram shall have all cable runs and patch points identified by alphanumeric characters.

### 3.16 TRAINING

- A. The AV Contractor shall provide up to forty-eight (48) hours instruction in the safe and proper operation of the equipment, in particular the audio DSP, sound console, and control systems, to the owner's designated representatives.
1. AV Contractor shall schedule instruction with the Owner's designated representatives.
  2. Instruction shall not necessarily follow immediately after the system commissioning.
  3. Instruction shall be independent of the system check-out and activation. Duration of system commissioning shall not affect the length of instruction time.
  4. Instruction, at Owners discretion, may occur in multiple time blocks of less than eight (8) hours each.
  5. AV Contractor shall be responsible for making and furnishing video documentation of instruction for future viewing to the Owner. Video documentation can be requested by the owner up to the entire (48) hours of instruction as detailed in this section, and shall be furnished to the owner as individual .mp4 files per training session. Files shall be labeled by the contractor indicating the date of training and a brief description of the content of the video. All files shall be furnished to the owner on a USB storage device provided by the contractor.

**END OF SECTION**

Room Type / Number	Description	Manufacturer	Model/Part #	Qty	Notes
A101 Lobby	Ceiling Loudspeaker	JBL	Control 47 C/T	4	Flush mount.
A101 Lobby	Ceiling Loudspeaker	JBL	Control 64 P/T	8	Surface mount pendant (above wood slat ceiling).
A101 Lobby	Video Display - 65"	Samsung	QM65C	2	
A101 Lobby	Video Display - 55"	Samsung	QM55C	2	
A101 Lobby	Display Mount - 55"	Contractor Nom.	Contractor Nom.	2	Contractor nominated.
A101 Lobby	Display Mount - 65"	Contractor Nom.	Contractor Nom.	2	Contractor nominated.
A101 Lobby	AVoverIP Receiver	Aurora	VPX-TC1-PRO	4	
A101 Lobby	Digital Signage Player	BrightSign	XT5	4	
A103 Concessions / Box Office	House Mgr Touchscreen - 7"	QSYS	TSC-70-G3	1	
A103 Concessions / Box Office	ALS - Receivers	Listen Tech	LR-4200-072	32	
A103 Concessions / Box Office	ALS - Neck Loops	Listen Tech	LA-438	8	
A103 Concessions / Box Office	ALS - Charging Case	Listen Tech	LA-311	2	
A103 Concessions / Box Office	ALS - Signage	Listen Tech	LA-304	1	
A105 Womens Toilets	Ceiling Loudspeaker	JBL	Control 47 C/T	1	Flush mount.
A106 Drama Office	Ceiling Loudspeaker	JBL	Control 47 C/T	1	Flush mount.
A106 Drama Office	Volume Control	QSYS	Axon C1	1	
A108 Unisex Toilet	Ceiling Loudspeaker	JBL	Control 47 C/T	1	

A110 Mens Toilets	Ceiling Loudspeaker	JBL	Control 47 C/T	1	Flush mount.
A112 BOH Hall	Ceiling Loudspeaker	JBL	Control 47 C/T	9	Flush mount.
A116 Workshop	Ceiling Loudspeaker	JBL	Control 64 P/T	4	Surface mount pendant.
A116 Workshop	Volume Control	QSYS	Axon C1	1	
A118 Open Circulation	Ceiling Loudspeaker	JBL	Control 47 C/T	2	Flush mount.
A124 Band Storage	Ceiling Loudspeaker	JBL	Control 64 P/T	3	Surface mount pendant.
A124 Band Storage	Volume Control	QSYS	Axon C1	1	
A128 Dressing Room	Ceiling Loudspeaker - Flush Mount	JBL	Control 47 C/T	2	
A128 Dressing Room	Volume Control	QSYS	Axon C1	1	
A129 Dressing Room	Ceiling Loudspeaker	JBL	Control 47 C/T	2	Flush mount.
A129 Dressing Room	Volume Control	QSYS	Axon C1	1	
A130 Makeup	Ceiling Loudspeaker	JBL	Control 47 C/T	2	Flush mount.
A130 Makeup	Volume Control	QSYS	Axon C1	1	
A143 Sound & Lighting Store	Volume Control	QSYS	Axon C1	1	
A143 Sound & Lighting Store	Ceiling Loudspeaker	JBL	Control 64 P/T	2	Surface mount pendant.
A148 Audience Chamber	Facilities Panel - FB1	Custom	By Contractor	1	
A148 Audience Chamber	Performance Loudspeakers - LCR Arrays - Upper Cabinet	d&b audiotechnic	ALi60	3	
A148 Audience Chamber	Performance Loudspeakers - LCR Arrays - Lower cabinets	d&b audiotechnic	ALi90	6	

A148 Audience Chamber	Loudspeaker Rigging - LCR Arrays	d&b audiotechnic	Ali Mounting Frame	3	
A148 Audience Chamber	Performance Loudspeakers - Subwoofer	d&b audiotechnic	21S	4	
A148 Audience Chamber	Loudspeaker Rigging - Subwoofer	d&b audiotechnic	21S-SUB Horizontal bracket with extension bars	2	Provide extension bars for two flown arrays of 2.
A148 Audience Chamber	Performance Loudspeaker - Delay	d&b audiotechnic	10S	3	
A148 Audience Chamber	Loudspeaker Rigging - Delay	d&b audiotechnic	Horizontal Bracket	3	
A148 Audience Chamber	Performance Loudspeaker - Front Fill	d&b audiotechnic	4S	5	
A148 Audience Chamber	Loudspeaker Rigging - Front Fill	d&b audiotechnic	AS required	5	
A148 Audience Chamber	Room Microphone (ALS)	Shure	MX202W - Supercard	1	
A148 Audience Chamber	Wireless Microphone Antenna	Shure	UA874	1	
A148 Audience Chamber	PTZ Camera	Panasonic	UE40 White	1	
A148 Audience Chamber	Camera AVoverIP Transmitter	Aurora	VPX-TC1-PRO	1	
A148 Audience Chamber	Facilities Panel - AV7	Custom	By Contractor	2	
A148 Audience Chamber	Facilities Panel - AV3	Custom	By Contractor	1	
A148 Audience Chamber	Facilities Panel - AV4	Custom	By Contractor	1	
A148 Audience Chamber	Digital Mixing Console (provide Dante card & road case for console)	Allen & Heath	SQ-7	1	Include 10' Cable assembly for Dante P&S (tactical style cable with
A148 Audience Chamber	Playback Rack (contains media player, computer, and audio interface)	Gator	G-PROR-4U-19	1	
A148 Audience Chamber	Media Player w. BT	DENON	DN-500CB	1	
A148 Audience Chamber	Playback computer - Allow \$1500	Apple	MacMini (Exact Specifications to be established during	1	

A148 Audience Chamber	Computer Rack Mount	Sonnet	RackMac Mini	1	
A148 Audience Chamber	Audio Interface	Presonus	Studio 1824c	1	
A148 Audience Chamber	Computer Display	Dell	U2415	1	
A148 Audience Chamber	Playback Software (Allow \$1200)	QLAB 5	Confirm feature sets required before purchase	1	
A148 Audience Chamber	Playback Cable Assembly - connecting Audio interface to mixer	Custom	By Contractor		
A149 Stage	Touchpanel	QSYS	TSC-70-G3	1	
A149 Stage	Wireless Microphone Antenna	Shure	UA874	2	
A149 Stage	Video Transmitter (installed in FP)	Aurora	VPX-TC1-WP2 (BLACK)	2	
A149 Stage	Facilities Panel - AV1	Custom	By Contractor	1	
A149 Stage	Facilities Panel - AV2	Custom	By Contractor	1	
A149 Stage	Facilities Panel - AV5	Custom	By Contractor	1	
A149 Stage	Facilities Panel - AV6	Custom	By Contractor	1	
A149 Stage	Projection Screen in proscenium header	Draper	Paragon V	1	
A149 Stage	Facilities Panel - ICA2	Custom	By Contractor	1	
A196 FOH Hall	Ceiling Loudspeaker	JBL	Control 47 C/T	3	Flush mount.
A201 - Upper Lobby	Ceiling Loudspeaker	JBL	Control 47 C/T	4	Flush mount.
A201 - Upper Lobby	Video Display - 65"	Samsung	QM65C	1	
A201 - Upper Lobby	Display Mount	Contractor Nom.	Contractor Nom.	1	Contractor nominated.

A202 - Womens Toilets	Ceiling Loudspeaker	JBL	Control 47 C/T	2	Flush mount.
A204 Mens Toilets	Ceiling Loudspeaker	JBL	Control 47 C/T	2	Flush mount.
A207 Projection / Control Rm	Video Projector	Barco	G100-W22	1	
A207 Projection / Control Rm	Projector Mounting	Contractor Nom.	Contractor Nom.	1	Contractor nominated.
A207 Projection / Control Rm	Video Receiver	Aurora	VPX-TC1-LT	1	
A207 Projection / Control Rm	Volume Control	QSYS	Axon C1	1	
A207 Projection / Control Rm	Ceiling Loudspeaker	JBL	Control 47 C/T	2	Flush mount.
A207 Projection / Control Rm	Facilities Panel - AV8	Custom	By Contractor	1	
A207 Projection / Control Rm	Facilities Panel - AV9	Custom	By Contractor	1	
A302 Follow Spot	Volume Control	QSYS	Axon C1	1	
A302 Follow Spot	Facilities Panel - AV10			1	
A303 AV & Ltg Rack Room	Assisted Listening System (ALS) RF Transmitter (216 MHz)	Listen Tech	LT-800-216-01	1	
A303 AV & Ltg Rack Room	ALS RF Antenna Kit (Antenna in House)	Listen Tech	LA-122	1	
A303 AV & Ltg Rack Room	ALS Intellegent DSP RF Receiver (216MHz)	Listen Tech	LR-4200-216	33	
A303 AV & Ltg Rack Room	AV Rack - Gangable, 40U, Rear Door only	Middle Atlantic	BGR-4527-AV	2	
A303 AV & Ltg Rack Room	AV Rack - Power Distribution	Contractor Nom.	Contractor Nom.	2	Contractor nominated.
A303 AV & Ltg Rack Room	AV Rack - Fans	Contractor Nom.	Contractor Nom.	2	Contractor nominated.
A303 AV & Ltg Rack Room	AV Rack - UPS	Contractor Nom.	Contractor Nom.	2	Contractor nominated.

A303 AV & Ltg Rack Room	Installed Wireless Microphone Receiver - 4chan	Shure	ULXD4Q	1	
A303 AV & Ltg Rack Room	Digital Signage Processor	QSYS	Core 110f	1	Provide all necessary licensing required by the system design.
A303 AV & Ltg Rack Room	DSP - GPIO Interface	QSYS	QIO-GP8x8	1	Provide all necessary licensing required by the system design.
A303 AV & Ltg Rack Room	DSP - Serial Interface	QSYS	QIO-S4	1	Provide all necessary licensing required by the system design.
A303 AV & Ltg Rack Room	Power Amplifier - Type 1	d&b audiotechnic	40D	4	
A303 AV & Ltg Rack Room	Power Amplifier - Type 2	d&b audiotechnic	10D	2	
A303 AV & Ltg Rack Room	Power Amplifier - Type 3 - Stage Patching	Dynacord	IPX 5 4	1	
A303 AV & Ltg Rack Room	Power Amplifier - Type 4 - Distributed Audio Lobby/Band	Dynacord	V600 2	2	
A303 AV & Ltg Rack Room	Power Amplifier - Type 4 - Distributed Audio Rooms	Dynacord	V600 4	2	
A303 AV & Ltg Rack Room	Video Switcher			1	
A303 AV & Ltg Rack Room	Network Switch - 24 Port (Control)	Netgear		1	
A303 AV & Ltg Rack Room	Network Switch - 24 Port (AoverIP)	Netgear		2	
A303 AV & Ltg Rack Room	Intercom Power Supply - 2 chan	Clear-Com	MS-702	1	
A303 AV & Ltg Rack Room	Digital Console Stage Box - Rack Mount	Allen & Heath	DT168	1	Mount in Rack for XLR Patching
E100 Band Room	Volume Control	QSYS	Axon C1	1	
E100 Band Room	Ceiling Loudspeaker	JBL	Control 67 P/T	4	Surface mount pendant.
E100 Band Room	Playback Loudspeaker with mount	JBL	Control 5	2	
E100 Band Room	Power Amplifier	Dynacord	L2800FD	1	

E100 Band Room	Digital Signal Processor	QSYS	Core 110f	1	
E100 Band Room	Network Switch - 12 port	Netgear	M4300 Series		Contractor to verify number of ports required.
E100 Band Room	Bluetooth Interface	QSYS	und6io-BT	1	
E100 Band Room	Network Audio Recorder			1	
E100 Band Room	Video Transmitter	Aurora Multimedia	VPX-TC1-WP2-PRO	2	
E100 Band Room	Video Receiver	Aurora Multimedia	VPX-TC1-PRO	1	
E100 Band Room	Wall Mounted Rack	Middle Atlantic	DWR-24-22PD	1	
E100 Band Room	Power Distribution Unit	Contractor Nom.	Contractor Nom.	1	Contractor nominated.
E100 Band Room	UPS - Rack Mounted	Contractor Nom.	Contractor Nom.	1	Contractor nominated.
E100 Band Room	Rack Drawer	Middle Atlantic	UD3	1	
E100 Band Room	Touchpanel	QSYS	TSC-70-G3	1	
E100 Band Room	Video Projector	Barco	i600-4k8	1	
E100 Band Room	Projector Lens	Barco	R9803070	1	
E100 Band Room	Projector Mount	Contractor Nom.	Contractor Nom.	1	Contractor nominated.
E100 Band Room	Projection Screen	Draper	Profile+	1	Fixed, wall mounted.
E100 Band Room	Facilities Panel - AV11	Custom	By Contractor	1	
E100 Band Room	Recording Microphone	Neumann	KM 183	2	
E100 Band Room	Preamplifier	Grace	m201mk2	1	



E106 Percussion	Volume Control	QSYS	Axon C1	1	
E106 Percussion	Ceiling Loudspeaker	JBL	Control 67 P/T	3	Surface mount pendant.
Portable Equipment	Digital Mixing Console - Portable Stage Box	Allen & Heath	DT168	2	
Portable Equipment	SM Com/CTL Rack consisting of the following: (1) Gator 6U (1) Extron TLP Pro 525M (1) ClearCom RM-702 (1) APC NET9RMBLK Surge Power Distro (1) LittLite Rack Lite - RL-10-D-LED (1) AKG DGN99 E (1) Rear Rack Panel for connection points (1) Custom Page panel for touchpanel & XLR R Page mic receptacle	Custom	By Contractor	1	
Portable Equipment	SM Video Rack containing the following: (1) Gator 3U (1) M-LYNX-702 V.3 (2x 7" Display) Custom Rear Panel	Custom	By Contractor	1	
Portable Equipment	Intercom - Single Channel Beltpack	Clear-Com	RS-701	8	
Portable Equipment	Intercom - Lightweight Headset Single Ear	Clear-Com	CC-110	9	
Portable Equipment	Foldback Loudspeaker - Wedge	EV	TX1122FM	2	
Portable Equipment	Foldback Loudspeaker - Cabinet	EV	ZLX-8-G2	2	
Portable Equipment	Loudspeaker Cable - 5'	Lex Products	LPA-SPK12/4-005	2	
Portable Equipment	Loudspeaker Cable - 10'	Lex Products	LPA-SPK12/4-010	4	
Portable Equipment	Loudspeaker Cable - 25'	Lex Products	LPA-SPK12/4-025	4	
Portable Equipment	Loudspeaker Cable - 50'	Lex Products	LPA-SPK12/4-050	2	
Portable Equipment	Loudspeaker Cable - Barrel	Neutrik	NL4MMX	2	

Portable Equipment	Microphone Cable - 5'	Lex Products	LPA-XLR-20/2-005	6	
Portable Equipment	Microphone Cable - 10'	Lex Products	LPA-XLR-20/2-010	8	
Portable Equipment	Microphone Cable - 25'	Lex Products	LPA-XLR-20/2-025	10	
Portable Equipment	Microphone Cable - 50'	Lex Products	LPA-XLR-20/2-050	2	
Portable Equipment	TRS Cable - 5'	Lex Products	LPA-TRS-20/2-005	4	
Portable Equipment	CAT6 Cable - Ethercon (tactical cable type)	Lex Products	CAT6S-EC-25	2	
Portable Equipment	CAT6 Cable - Ethercon (tactical cable type)	Lex Products	CAT6S-EC-50	1	
Portable Equipment	Power Cable - 25' 5-20 to 5-20 Quad	CBI Cables	QB-R-25	2	
Portable Equipment	XLR Patch Cable - AUDIO - 12" (Red)	By Contractor	By Contractor	4	
Portable Equipment	XLR Patch Cable - AUDIO - 24" (Yellow)	By Contractor	By Contractor	8	
Portable Equipment	XLR Patch Cable - AUDIO - 30" (Blue)	By Contractor	By Contractor	4	
Portable Equipment	Patch Cable - Loudspeaker - NL4 - 18"	By Contractor	By Contractor	4	
Portable Equipment	Patch Cable - Loudspeaker - NL4 - 30"	By Contractor	By Contractor	4	
Portable Equipment	Video Patch Cable 12-G - 12" (Green)	Canare/Bittree/	By Contractor	4	
Portable Equipment	Video Patch Cable 12-G - 24" (Purple)	Canare/Bittree/	By Contractor	4	
Portable Equipment	Video Patch Cable 12-G - 36" (Brown)	Canare/Bittree/	By Contractor	2	
Portable Equipment	Wireless Microphone - Handheld Transmitter	Shure	ULXD2/B58	4	
Portable Equipment	Wireless Mic - Body Pack Transmitter	Shure	ULXD1	4	

Portable Equipment	Wireless Mic - Lav Microphone (Wired for S	Point Source	CO-8WL	4	
Portable Equipment	Wireless Mic - Recharable Batteries	Shure	SBC900A	8	
Portable Equipment	Wireless Mic - Dual Charger (provide 2 with	Shure	SBC200US	4	
Portable Equipment	Dynamic Microphone - Handheld A	Shure	SM58	4	
Portable Equipment	Dynamic Microphone - Handheld B	Shure	SM57	4	
Portable Equipment	Dynamic Microphone - Instrument A	AKG	D112	1	
Portable Equipment	Dynamic Microphone - Instrument B	Shure	Beta56	2	
Portable Equipment	Condenser Microphone - A	Shure	SM81	2	
Portable Equipment	Condenser Microphone - B	Shure	Beta98AMP/C	4	
Portable Equipment	Condenser Microphone - C (HH - Lead Voca	Shure	KSM9	2	
Portable Equipment	Direct Box - Active	Radial		2	
Portable Equipment	Direct Box - Passive	Radial	JDI	2	
Portable Equipment	Microphone Case - Wired Mics	Gator	GM-16-MIC-WP	1	
Portable Equipment	Microphone Case - Wireless	Gator	GM-04-WMIC-WP	1	
Portable Equipment	Microphone Stand - Straight	Atlas	MS-12CE	4	
Portable Equipment	Microphone Stand - Tripod w. boom	K&M	210/9	4	
Portable Equipment	Microphone Stand - Short Tripod w. boom	K&M	259	2	
Portable Equipment					

Portable Equipment	Intercom - Speaker Station in box (Biscuit)	ClearCom	KB702 + V-Box	1	
Portable Equipment	Intercom - Handset	ClearCom	HS-6	1	
Portable Equipment	Intercom - Call Flasher	ProIntercom	Blazon180	1	
Portable Equipment	Power Cable - 3-phase (L21-30) - 5'	Lex Products	PE105-005-L2130	1	
Portable Equipment	Power Cable - 3-phase (L21-30) - 20'	Lex Products	PE105-025-L2130	1	
Portable Equipment	L21-30 Breakout - to 6x Edison (BentoBox)	Lex Products	BNB3-3B	1	
Portable Equipment	Audio Adapter Kit	Comprehensive	ADAP-1	1	
Portable Equipment	Audio Testing Device	Whirlwind	Qbox	1	
Portable Equipment	24x48 Platform Cart	Uline	H-4147	1	

End of 27 41 16 Schedule A

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## SECTION 27 51 24

### EDUCATIONAL INTERCOM AND PROGRAM SYSTEMS

#### PART 1 - GENERAL

##### 1.1 GENERAL

- A. Section includes microprocessor-switched, IP-based telephone/intercommunications and program systems with the following components:
  - 1. Telephone system interface.
  - 2. Administrative control consoles.
  - 3. Emergency intercom call switches.
  - 4. Volume control stations.
  - 5. Amplifiers.
  - 6. IP-based loudspeakers/speaker microphones.
  - 7. Wire-guards.
- B. Related Requirements:
  - 1. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".
  - 2. Section 26 05 33 "Raceways and Boxes for Electrical Systems".
- C. Provide completely functional and turnkey integration with Owner-provided telephone system for communications and control. Coordinate interface with Owner's telephone system provider.
- D. System shall include connection to a national time standard synchronized programmable master clock or same internet source utilized by the system program clock system.
- E. Include complete interface with audio program playback equipment.
- F. System shall include three (3) administrative consoles. Locate one (1) in the main office, one (1) at the intercom rack, and one (1) at a location to be determined by the Owner.
- G. Include line level audio and relay interface between intercom system and each public address/sound reinforcement audio systems for priority muting.
- H. Provide complete system design, installation, programming, commissioning, and testing.

##### 1.2 DELEGATED DESIGN AND IMPLEMENTATION

- A. Contractor shall provide the complete system design and its implementation in accordance with the Contract Documents. Refer to Action Submittals for project-specific design documentation required.
- B. Include all hardware, firmware, software, programming, electric power, cabling pathways/raceways/supports, electrical boxes, cabling, and all system components to be supplied and installed for a complete and functional turnkey system—without exception. To achieve this, this contractor and subcontractors shall be responsible under this contract for determining—prior to submitting bid—existing equipment/field conditions, complete requirements for new work and the delineation of all work amongst qualified installers and technicians necessary for a fully functional and professional installation.

##### 1.3 DEFINITIONS

- A. DHCP: Dynamic Host Configuration Protocol
- B. FXO: Foreign eXchange Office
- C. H.323: Audio and Video Protocol
- D. IP: Internet Protocol
- E. IP Speaker: All-in-one IP-enabled network speaker or an analog speaker with remote IP adapter interface, amplification, and PoE connectivity.
- F. LAN: Local Area Network
- G. PoE: Power-over-Ethernet
- H. SIP: Session Initiation Protocol
- I. UTP: Unshielded Twisted Pair cabling

#### 1.4 ACTION SUBMITTALS

- A. Delegated Design Submittal: For items listed below, indicate compliance with performance requirements and design criteria, including analysis data.
  - 1. Cabling diagrams and network topology, including fiber optic.
  - 2. Speaker sound level output at each location.
  - 3. Amplifier locations and output.
  - 4. Quantities, types, and locations of PoE switches and patch panels.
  - 5. Battery sizing calculations.
  - 6. Voltage drop calculations.
- B. Product Data: For each type of product.
- C. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include scaled drawings for administrative console arrangement of built-in equipment.
  - 4. Include diagrams for power, signal, and control wiring.
    - a. Identify terminals to facilitate installation, operation, and maintenance.
    - b. Single-line diagram showing interconnection of components.
    - c. Cabling routings, pathways, raceways, conduits, supports, and sleeves.
- D. Qualification Data: For Installer and testing agency.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For educational intercommunications and program systems to include in operation and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  - 1. A record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.
  - 2. A record of Owner's equipment-programming option decisions.
  - 3. Plans, drawn to scale, indicating location, designation, and connection of intercommunications system components.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On USB media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
- C. Field quality-control reports.
- D. Warranty Documents: For special warranty.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.
  - 1. Testing Agency's Field Supervisor: Certified by NICET as Audio Systems Level II or Level III Technician.
  - 2. The contracting firm shall have full-service facility located within 2 hours driving time of project location and shall be a fully equipped service organization capable of providing full maintenance and service of the installed system within 24 hours of notification.
- C. Source Limitations: Obtain educational intercommunications and program systems from single source from single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for location and application.
- E. Comply with NFPA 70.
- F. Underwriters Laboratories, Inc.:
  - 1. UL 486A-91: Wire connectors and soldering lugs for use with copper conductors.
  - 2. UL 1449-85: Transient voltage surge suppressers.
  - 3. Comply with UL 1863.

4. Comply with UL listing WYQQ UL 1459.
  - G. Electronics Industries Association:
    1. EIA 568-91: Commercial Building Telecommunications Wiring Standard.
    2. EIA-160: Sound Systems.
    3. EIA-299A: Loudspeakers, Dynamic Magnetic Structures and Impedance.
    4. EIA-310A: Racks, Panels and Associated Equipment.
    5. SE-101-A: Amplifier for Sound Equipment.
  - H. Federal Communications Commission:
    1. FCC Regulations, Part 15, Title 47, and Part 68.
  - I. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for location and application.
  - J. Weather-Resistant Equipment: Listed and labeled by an NRTL for duty outdoors or in damp locations.
  - K. This contract shall include all hardware, firmware, software, programming, electric power, cabling pathways/raceways, electrical boxes, cabling, outside plant (if applicable), and all system components to be supplied and installed for a complete and functional turnkey system—without exception. To achieve this, this contractor and subcontractors shall be responsible under this contract for determining—prior to submitting bids—any existing equipment or field conditions as applicable, complete requirements for new work and the delineation of all work amongst qualified installers and technicians necessary for a fully functional and professional installation.
- 1.7 WARRANTY
- A. All products specified in this Section shall be provided with a special warranty in which the manufacturer agrees to repair or replace products provided under this contract that fail in materials or workmanship within the specified warranty period.
    1. Special Extended Warranty Period: Shall exceed four (4) years starting from the date of Substantial Completion.
      - a. If the manufacturer's warranty commences upon the date materials are delivered, then the manufacturer's warranty period shall be at least five (5) years to meet the requirement stated above.
    2. Make available a service contract offering to Owner to continue factory authorized service of this system. All labor and materials shall be provided at no expense to the Owner during other-than-normal working hours.
    3. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the warranty period.
- 1.8 COORDINATION
- A. Coordinate layout and installation of ceiling-mounted speaker microphones and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
  - B. Coordinate human interface with VoIP phone system and handsets provide by Owner.
  - C. Coordinate interface with fire alarm notification system. School intercom speakers shall be muted whenever audio signals and messaging notifications are being broadcast over the fire alarm speakers.
  - D. Coordinate with the Division-26 electrical contractor and the Division-27 telecom contractor providing horizontal/ backbone cabling/hardware/racks to accommodate intercom system equipment/components and to provide fiber/copper cabling infrastructure as needed. This contractor (providing the school intercom system) may utilize up to 4RU of rack space available in the lower portion of one IT equipment rack located in each IDF telecom room to accommodate distributed intercom cabling and electronic hardware. This contractor shall provide a dedicated equipment rack for the school intercom headend equipment in the main MDF telecom room.
  - E. This intercom system may utilize a single spare LAN backbone fiber-optic pair and one (1) connection to the Owner's LAN for programming purposes only. Coordinate such provisions directly with Owner's information technology manager. In all other respects, this system shall function independently of Owner-supplied network equipment and servers. Provide all necessary system equipment and components for a complete and functional system.

## PART 2 - PRODUCTS

### 2.1 SYSTEM MANUFACTURER

- A. Subject to compliance with all requirements, provide system components, equipment, and products by one of the following:
1. Bogen Communications, Inc.
  2. Rauland-Borg Corporation
  3. Telecor, Inc.

### 2.2 SYSTEM DESCRIPTION

- A. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz in a satisfactory manner without the requirement of any external power conditioning equipment. Comply with UL 813.
- B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.
1. System features including time tone scheduling shall be modifiable via software. Time schedules shall be programmable via software installed on Owner's designated computer. System programming shall be available from any connection on the Owner's network. System shall provide minimum 8 separate schedules with up to 256 events.
  2. Provide amplifier system for paging and public address throughout the facility for up to 240 remote stations/speaker locations. The system shall support two (2) channels of audio program material, with the program source being an AM/FM tuner. System shall have additional inputs to accommodate Owner-furnished media players mounted in same equipment rack as AM/FM tuner.
  3. Provide capability and programming for up to four (4) distinct zones of paging.
- C. Integration: Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- D. Local Area Network: The system will utilize a LAN for the connectivity of all devices and components within the facility for the transmission of electronic data. The LAN will be an expansion to the existing or a separate standalone structure in support of the intercommunication system as dictated by the project design documents.
- E. Features and Functions:
1. Audio program to classrooms.
  2. Automatic pre-announce and privacy tones.
  3. Priority emergency paging, as well as all-call paging.
  4. Hands-free intercom speaker communication.
  5. Manual and automatic electronic gain control VOX circuitry on intercom speakers to maintain constant speech and adjust to background noise levels.
  6. Ability to control up to eight relays both manually and through timed functions.
  7. Receive capability from up to six (6) sense inputs that are field programmable for emergency functions.
    - a. Provide fully functional tornado alarm feature in this contract.
  8. All programmable functions to be saved in battery-backed ram to prevent loss in a power failure condition.
  9. Classroom IP speakers and Owner-provided telephones are to operate independently and simultaneously to provide two simultaneous paths of Voice Communications to each classroom and other areas as designated. When using the telephone for voice communications it must still be possible to call that location via the intercom speaker(s) at that location.
- F. Special Features and Functions:
1. System shall enable remote emergency communications via telephone communications. With proper system security authorization, the Owner shall be capable of remotely calling into the system to access security emergency public address features.
  2. Provide "March-to-Music" feature. Coordinate with Owner prior to bidding.



## 2.3 FUNCTIONAL DESCRIPTION OF IP-BASED TELEPHONE/INTERCOMMUNICATION SYSTEMS

### A. Integrated central system with the following:

1. Direct-dial, full duplex private telephone communications between all locations equipped with Owner-provided telephones and IP-addressable speaker-microphone. Call initiation among administrative consoles and between administrative consoles and remote stations by dialing station's number on a 12-digit keypad.
2. Sixteen (16) channels for unrestricted simultaneous communications.
3. Initial system operation with up to three (3) administrative consoles and 240 stations, expandable to 720 stations.
4. Direct-dial, two-way amplified voice intercommunication between administrative console telephones and remote stations without use of press-to-talk or talk-listen switches.
5. Automatic queuing for intercommunication channels, with automatic call waiting.
6. Call transfer among administrative consoles.
7. Display of selected station and answering calling station by pressing a single "response button."
8. Simultaneous communication with other stations on system by dialing a designated number on a 12-digit keypad.
9. Automatic gain control to ensure constant intercom speech level.
10. Simultaneous distribution of emergency announcements to all locations equipped with speakers by dialing a predetermined code number.
11. User-selectable facility for providing selected Owner-provided telephone stations with dial tone for external telephone calls.
12. Assignment of speaker locations within any one or more of four (4) all-call zones for zone paging or time signal reception.
13. Digital readout displays on which up to three incoming calls are displayed with additional calls stored for subsequent display.
14. Off-site diagnostics to monitor system functions, operations, and faults through a serial data port on central-control station.
15. Control of simultaneous distribution of program material to various combinations of remote stations or groups by using keypad to control sources and distribute programs.
16. User-programmable features include the following:
  - a. Station calling by room number.
  - b. Room station call-in priority levels.
  - c. Audible signal schedule functions.
  - d. Schedule characteristics of audible signals.
  - e. Call-in tone characteristic.
  - f. Precedence among administrative consoles as destinations for incoming calls from room stations.
  - g. Grouping rooms and speakers into zones for paging and program distribution purposes.
17. Telephone interconnect shall be capable of accepting H.323, SIP, and FXO type protocols and include the following features:
  - a. Direct connection to central office trunk lines with initial system wiring for two (2) trunk lines.
  - b. Routing of outside trunk lines for "attendant answer incoming" and "direct inward line" functions.
  - c. Station programming for access to outside trunk lines to be any of the following:
    - 1) Totally unrestricted access.
    - 2) Restricted access.
    - 3) No access.
  - d. System programming to allow or disallow local prefixes, and to authorize access for as many as three area codes.
  - e. Discriminating ringing for identifying internal and outside calls.
  - f. Circular hunting for outside trunks to prevent excess usage of any one trunk.
  - g. Direct connection of a single trunk to designated Owner-provided telephone with transfer to attendant if unanswered.
  - h. Call parking allowing paged party to remotely pick up outside call from any station.
  - i. Night-answer mode to allow one or all of the following:
    - 1) Incoming call transferred to predetermined extension.
    - 2) Tone transmitted to speakers to notify key personnel to answer Owner-provided telephone.
    - 3) Dial tone to remote stations to allow answering call from all locations.
  - j. Call control console to perform as follows:
    - 1) Identify, answer, and route incoming outside calls, with reminder and recall features.

- 2) Directly access outside trunk lines.
  - 3) Hold, park, and transfer calls.
  - 4) Screen outside calls.
  - k. Capable of placing outside call.
  - l. Ability to transfer calls.
  - m. Call forwarding functions.
  - n. Paging and emergency call placement.
  - o. Speed-dial programming.
  - p. Programmable restrictive functions.
  - q. Communicating hands free.
  - r. Calling administrative console by actuating call switch.
  - s. Returning a busy signal to indicate that station is already in use.
- B. IP Speakers: Free of noise and distortion during operation and when in standby mode.
- 2.4 TELEPHONE SYSTEM INTERFACE
- A. Provide interface for PBX system integration by zone. This system must be integrated with the Owner-provided telephone system. All necessary additional intercom system components shall be included in this contract.
- 2.5 ADMISTRATIVE CONTROL CONSOLE
- A. Microprocessor-based instrument to process outside and internal calls with a 12-digit keypad selector.
- B. 20-character alphanumeric display for the following:
- 1. Simultaneous display of up to three calling stations plus last station dialed.
  - 2. Display of calls in order received with emergency calls taking precedence on the display.
  - 3. Review of calls stored in groups of four.
  - 4. Display of prompt messages to assist in system operation.
- C. Programmable Keys: Minimum of 20 with LED indicators for ringing/busy status; programmable for trunk and operator functions.
- D. Transfer Button: Calls to busy extensions and unanswered calls automatically returned to call control console.
- E. Hold Button: With reminder feature every 30 seconds for parked calls or calls placed on hold.
- F. Release Button: For use with parked calls or calls placed on hold.
- G. Page Button: For engaging system paging functions.
- H. Programmable for night answer, remote answer, and remote pickup features.
- I. Programmable for distribution of emergency announcements, all-page announcements, zone-page announcements, and emergency/evacuation alert.
- J. Central-Control Cabinet Equipment: Central switching equipment, central office adapter module, line link modules, power supplies, chassis adapters, and other switching and control devices required for trunk and internal conversation channels and control functions.
- K. Enclosure: Galvanized steel with minimum depth.
- L. 12-Digit Keypad: Input device to initiate calls and commands.
- M. Volume Control: Regulates incoming-call volume.
- N. Tone Annunciation: Momentary audible tone signal announces incoming calls.
- O. LED Annunciation: Identifies calling stations and stations in use. Lamp remains on until call is answered.
- P. Speaker Microphone: Transmits intercom voice signals when used via a voice-operated switch.
- Q. Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.
- R. Enclosure: Two-gang galvanized steel with minimum depth.
- S. Speaker: Minimum axial sensitivity shall be 91 dB at one meter, with 1-W input. Voice coil shall be not less than minimum; permanent magnet.
- T. Tone Annunciation: Recurring momentary tone indicates incoming calls.
- U. Call Switch: Mount on faceplate. Permits calls to administrative console.

- V. Privacy Switch: Mount on faceplate. When in on position, switch prevents transmission of sound from remote station to system; when in off position, without further switch manipulation, response can be made to incoming calls.

## 2.6 EMERGENCY INTERCOM CALL SWITCHES

- A. Enclosure:
  - 1. Single-gang box, flush-mount, unless otherwise indicated.
  - 2. Stainless-steel faceplate or anodized aluminum with tamperproof screws.
  - 3. Engraved label on faceplate: "Emergency Call".
- B. Call Switch:
  - 1. Red rocker switch or button.
  - 2. Momentary contact signals system that an emergency call has been placed.
- C. Privacy Switch: Prevents transmission of sound signals from station to system.
- D. Volume Control: Operated by screwdriver blade through a hole in faceplate to adjust output level of associated speaker.

## 2.7 ALL-CALL AMPLIFIER

- A. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.
- C. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.
- D. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.
- E. Output Regulation: Maintains output level within 2 dB from full to no load.
- F. Input Sensitivity: Compatible with administrative console and central equipment so amplifier delivers full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on administrative console, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

## 2.8 INTERCOMMUNICATION AMPLIFIER

- A. Minimum Output Power: 15 W; adequate for all functions.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to one station connected to output terminals.
- C. Minimum Signal-to-Noise Ratio: 50 dB, at rated output.
- D. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 Hz.
- E. Output Regulation: Maintains output level within 2 dB from full to no load.
- F. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on microphones in administrative console, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

## 2.9 PAGING AMPLIFIER

- A. Input Voltage: 120-V ac, 60 Hz.
- B. Frequency Response: Within plus or minus 3 dB from 60 to 10,000 Hz.
- C. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.
- D. Total Harmonic Distortion: Less than 3 percent at rated output power from 70 to 12,000 Hz.
- E. Output Regulation: Less than 2 dB from full to no load.
- F. Controls: On-off, input levels, and low-cut filter.
- G. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphones or handset transmitters.
- H. Amplifier Protection: Prevents damage from shorted or open output.

2.10 CONE-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

- A. IP speaker, 2' x 2' class UL Listed speaker assembly designed for flush lay-in installation in suspended ceiling tile grid, where applicable. Provide conventional round speaker and baffle if installed in gypsum board ceiling or exposed structural ceiling. Provide square back-box enclosure for surface- or pendant-mount applications (exposed structural ceilings).
- B. PoE 802.3af enabled with RJ45 connectors. Configurable via web access, with onboard programmable control relay.
- C. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.
- D. Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.
- E. Coil Size: 8 inches with 1-inch voice coil and minimum 5-oz. ceramic magnet.
- F. Minimum Dispersion Angle: 100 degrees.
- G. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker rating, and at least four level taps.
- H. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch steel and whole assembly rust proofed and factory primed, complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.
- I. Baffle: For flush speakers, minimum thickness of 0.032-inch aluminum with textured white finish.
- J. High-impact or high-abuse applications as indicated on the Drawings: Vandal-Proof, High-Strength Baffle: For flush or surface-mounted speakers as applicable, self-aging cast aluminum with tensile strength of 44,000 psi, 0.025-inch minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.

2.11 HORN-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

- A. IP Speaker shall be all-metal, high-impact high-abuse weatherproof design, complete with universal mounting brackets.
- B. PoE 802.3af enabled with RJ45 connectors. Configurable via web access, with onboard programmable control relay.
- C. Wideband G.722 codec support for HD Voice.
- D. Auto-provisioning (i.e., TFTP, FTP, HTTP, HTTPS). Also supported: TLS & SRTP (secure SIP signaling and media), SIP over TCP (allows increased packet size over UDP), DNS SRV Record, and CDP/LLDP automatic VLAN assignment. SNMP supervision or via the Algo 8300 Controller. Internal memory of 1GB for uploading custom WAV files or recorded messages.
- E. Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.
- F. Minimum Power Rating of Driver: 15 W, continuous.
- G. Minimum Dispersion Angle: 110 degrees.
- H. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker rating, and at least four level taps.

2.12 IP ADDRESSABLE MODULES

- A. Modules utilized for the operation of the intercommunication and paging functions.
  - 1. POE 802.3af compliant.
  - 2. Support DHCP.
  - 3. RJ45 connectivity.
- B. Speaker Modules:
  - 1. Interface with speaker and multiple call switches.
  - 2. Capable of providing privacy function for speaker/microphone when activated.
  - 3. Rated for installation within air plenum spaces.

2.13 VOLUME CONTROL STATIONS

- A. Flush wall-mounted auto-transformer type with brushed stainless faceplate with black control knob and indicating digits. Ten step attenuation plus open position. Insertion loss less than 0.5 dB. Designed for IP speaker and/or 25V and 70V lines, if applicable.

2.14 TUNER/RECEIVER

- A. Approved Manufacturers:
  - 1. Marantz
  - 2. Denon
  - 3. Tascam
  - 4. (or intercom manufacturer label)
- B. Provide a rack mounted, AM/FM Digital Tuner operating on 120 VAC. The AM section shall be tunable over a range of 530 to 1610 Hz. The FM section shall be tunable over a range of 87.5 to 108MHz. The tuner shall have seek-and-scan, 20 preset station and digital readout. A CD player, if required, will be furnished by Owner.
  - 1. The system shall be able to receive external audio source input via the following methods:
    - a. USB – Type A
    - b. USB – Type C
    - c. 3.5mm audio jack
    - d. Bluetooth
    - e. SD Card
- C. Supply and install roof-mounted high-definition AM/FM antenna with lead-in cables, lightning arrestors, weatherhead, splitters, etc. Coordinate installation with Division 26 contractor and roofing contractor. Provide one of the following or approved equivalent:
  - 1. Shakespeare 5420-XT (Galaxy Little Giant)
  - 2. Pixel AFHD-4 (by DX Engineering)

2.15 EQUIPMENT RACK/CABINET

- A. Install all sound system components in a floor equipment cabinet assembly. Intercom system punch down blocks shall be provided on a nearby wall or located in the cabinet if so equipped. Provide blank panels as necessary to cover excess space. Cabinet shall include space for the intercom system UPS.
  - 1. Provide a dedicated rack in the main headend room for equipment associated only with this system. This equipment rack shall be enclosed, ventilated, and equivalent to Lowell model LER-4427LRD.

2.16 ELECTRICAL PROVISIONS

- A. Power Supply: Separately fused, 110-volt AC circuit fused with a circuit breaker of 20 amps.
- B. Power Strip: Protect the AC supply with a Tripp-Lite Model ISOBAR (IB) 2.0 AC outlet strip or equivalent by Geist, APC, Eaton, or Liebert.
- C. Grounding: The sound equipment shall be grounded to a unified building ground/bonding conductor consisting of #6 AWG insulated copper wire routed in conduit.
- D. Standby Power: UPS as described in this Section.

2.17 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. The UPS units shall be rack mounted within the intercom racks to protect the intercom master equipment. Unit shall be rated for 2200 VA minimum with a full load run time of 5 minutes with internal battery and contain at least six (6) outlets for equipment protection.
  - 1. Acceptable Manufacturers:
    - a. American Power Conversion (APC)
    - b. Eaton Corporation
    - c. Geist Manufacturing
    - d. Liebert Corporation
  - 2. Design Basis: APC Smart UPS SMT Series.
  - 3. Provide in quantities required to fully support system.
  - 4. Provide rack mounting adapters as required.
  - 5. Provide UL listed, 6 ft NEMA 5-20 extension cable to input of UPS to allow mounting in bottom of rack and connection to runway mounted receptacle.

2.18 CONDUCTORS AND CABLES

- A. General Conductors:
  - 1. Jacketed, twisted pair and twisted multi-pair as required by manufacturer, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 20 AWG.
  - 2. Insulation: Thermoplastic, not less than 1/32 inchthick.

3. Shielding: For speaker-microphone leads and elsewhere as recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.
    - a. Minimum Shielding Coverage on Conductors: 60 percent.
  - B. Category 5 UTP Cabling:
    1. Jacket Color: White.
    2. Type CMP, complying with NFPA 262.
    3. NRTL, UL 444, NFPA 70.
  - C. Plenum Cable: Listed and labeled for plenum installation.
- 2.19 RACEWAYS
- A. Educational Intercommunication and Program System Raceways and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
  - B. Outlet boxes shall be not less than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
  - C. Flexible metal conduit is prohibited.

### **PART 3 - EXECUTION**

#### **3.1 EXISTING CONDITIONS AND COORDINATION**

- A. Interruption of Existing Educational Intercom and Program System: Do not interrupt existing systems unless permitted under the following conditions:
  1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of systems. Coordinate with Owner the maximum allowable duration of each service interruption.
  2. Do not proceed with interruption of systems without Construction Manager's and the Owner's permission.

#### **3.2 WIRING METHODS**

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
  1. Install all cabling within raceways, unless located above accessible grid ceilings.
  2. Install plenum cable in environmental air spaces, including plenum ceilings.
  3. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

#### **3.3 INSTALLATION OF RACEWAYS**

- A. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

#### **3.4 INSTALLATION OF CABLES**

- A. Comply with NECA 1.
- B. General Requirements:
  1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  6. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used.
- C. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
  2. Suspend cable not in a wireway or pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
  3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.
- E. Refer to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" for additional wiring requirements.

### 3.5 INSTALLATION

- A. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- C. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- D. Circuiting of IP speakers for zone paging shall be per classroom, per groups for zone communications, per grade level, per corridor, and per functional workspace. Coordinate with Owner as needed for options as well as programming.
- E. Furnish and install wall-mounted volume controls where indicated on the drawings.
- F. Connect intercom system, including all-call amplifiers to UPS mounted in bottom of rack.
- G. Connect intercom system to Owner's PBX telephone/VoIP system. Install two (2) communications pathways between intercom and telephone system. Determine complete requirements prior to bidding.
- H. Connect intercom system to Owner's LAN network and install class program/bell schedule software on Owner's computers. Coordinate connectivity to LAN with Owner's IT department/director.
- I. Connect to national time standard synchronized programmable master clock or same internet source utilized by the system program clock system.
- J. Install line level audio and relay interface between intercom system and each public address/sound reinforcement audio systems for priority muting.
- K. Coordinate with fire alarm system interface to mute intercom system during an emergency notification alarm.
- L. Coordinate means of activating programmed tornado alarm directly with the Owner's representative.
- M. Connect to audio program playback located in rack and controlled from administrative consoles.

### 3.6 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.
- C. Connect intercom components to rack and bond rack to signal ground terminal with No. 6 AWG minimum green copper conductor. Remove all paint and foreign matter from contact surfaces before bonding ground lugs.
- D. Refer to Division 26 Section "Grounding and Bonding for Electrical Systems".

### 3.7 SYSTEM PROGRAMMING

- A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and a record documents report.
- B. System programming shall reflect actual room numbers and names (which are not the same as those shown on construction document floor plans). Coordinate with and obtain final approved list from the Architect/Owner.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: [Engage] [Owner will engage] a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
  - 1. Schedule tests with at least seven days' advance notice of test performance.
  - 2. After installing educational intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Operational Test: Test originating station-to-station, all-call, and page messages at each intercommunication station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
  - 4. Frequency Response Test: Determine frequency response of two transmission paths, including all-call and paging, by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.
  - 5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
    - a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at speakers.
    - b. Repeat test for three speaker microphones, and each administrative console microphone, and for each separately controlled zone of paging loudspeakers.
    - c. Minimum acceptable ratio is 45 dB.
  - 6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each intercom, paging, and all-call amplifier. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.
  - 7. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB; in levels between adjacent zones, plus or minus 5 dB.
  - 8. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
  - 9. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems."
- D. Inspection: Verify that units and controls are properly labeled and that interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.
- E. Educational intercommunications and program systems will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service and initial system programming.
  - 1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
  - 2. Complete installation and startup-checks according to manufacturer's written instructions.
  - 3. Assist with PBX integration to ensure interconnection and proper intercom system isolation and ensure intercom system integrity.



3.10 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three (3) visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. Include a minimum of 6 hours of on-site labor designated for this purpose plus all necessary travel time.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the educational intercommunications and program systems.
  - 1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.
  - 2. Conduct a total of seven (7) hours (minimum) of on-site training as specified in instructions to Owner's employees in Division 01 Section "Demonstration and Training." Training shall be divided into two (2) separate sessions (to occur on two separate days if requested by Owner. The first session shall provide two (2) hours of basic training. The second session shall provide five (5) hours of in-depth training. Coordinate training content/agenda, dates, and times directly with Owner.

END OF SECTION 27 51 24

## SECTION 28 05 00

### COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Electronic safety and security equipment coordination and installation.
  - 2. Raceway and Boxes for Electronic Safety and Security.
  - 3. Sleeves for pathways and cables.
  - 4. Sleeve seals.
  - 5. Grout.
  - 6. Common electronic safety and security installation requirements.
  - 7. Backboxes, raceways and power for all electronic safety and security system devices shown on Contract Drawings.
- B. This Section includes the following types of system rough-ins:
  - 1. Security equipped doors and frames.
  - 2. Closed circuit video cameras.
  - 3. Card readers.
- C. Related Sections:
  - 1. Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  - 2. Section 08 71 00 "Door Hardware" for electrified door hardware.
  - 3. Section 08 31 13 "Access Doors and Frames."
  - 4. Section 26 05 33 "Raceway and Boxes for Electrical Systems" for raceway and outlet boxes.
  - 5. Section 27 05 36 "Cable Trays for Communications" for cable tray systems.
  - 6. Section 28 46 00 "Fire Detection and Alarm Systems" for raceway, boxes and backboxes.

##### 1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

##### 1.3 SUBMITTALS

- A. Product Data: None

##### 1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. To assure connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate backbox, outlet box and power requirements with electronic safety and security equipment.
- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- E. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 07 84 13 "Penetration Firestopping."

- F. Coordinate rough-ins with surrounding surfaces to insure flush installations. Provide extension rings on device boxes to accommodate tack walls and surfaces.
- G. Coordinate ducts and sleeves with structural elements.

## **PART 2 - PRODUCTS**

### **2.1 RACEWAY AND BOXES FOR ELECTRONIC SAFETY AND SECURITY**

- A. All material and associated installation shall be as specified in appropriate Section 26 05 33 "Raceways and Boxes for Electrical Systems."

### **2.2 SLEEVES FOR PATHWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

### **2.3 CABLE SUPPORTS FOR CABLE PATHWAYS**

- A. Cable Supports (J-Hooks): Meets ISO/IEC 18010 and TIA-569-B. Steel hooks designed for communications cable support with cable retaining clip. Supports shall be capable of interlocking vertically to support multiple cable pathways. Supports shall be available in 1 inch thru 4 inch size. Supports shall be capable of attaching to beams, walls, threaded rod, and angled mounting brackets with compatible accessories.
  - 1. Provide single J-Hook cable supports from each communications cable stub-up to main cable support line or cable tray.
  - 2. Provide three (3) stacked cable supports minimum 5ft on center from individual rooms along main pathways to cable tray or serving communications room.
  - 3. Provide Erico Caddy CAT Link Series or approved equal.

### **2.4 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### **2.5 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## **PART 3 - EXECUTION**

### **3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION**

- A. General:
  - 1. Comply with NECA 1.
  - 2. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
  - 3. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

4. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications' equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
  5. Right of Way: Give to piping systems installed at a required slope.
  6. Provide rough-ins as specified herein at each location where the corresponding symbol is indicated on the Drawings.
  7. Mounting heights shall be as indicated in the Mounting Height Schedule unless otherwise indicated on the Drawings.
  8. Provide all raceways with protective insulation bushings at raceway termination.
  9. Provide junction/pull boxes at locations indicated or required.
  10. Flexible type raceways shall be secured and terminated in a double-gang box above accessible ceiling.
  11. Provide a blank coverplate for each rough-in not utilized by date of substantial completion.
- B. Security Equipped Doors and Frames:
1. See Contract Drawing details for specifications.
  2. Provide infrastructure per detail at all exterior doors and at interior doors at locations indicated on drawings.
- C. Closed circuit video cameras:
1. For exterior wall-mounted in precast, or metal panel walls: Provide flush 3-1/2" deep, single-gang box at locations indicated. Provide box support behind metal panel for camera mounting.
  2. For interior wall mounted or ceiling mounted non-accessible ceiling: Provide flush double-gang box with single-gang extension ring at locations indicated.
  3. Provide one (1) 3/4-inch raceway to nearest accessible ceiling. Include bushings at all raceway terminations.
- D. Card reader Outlets:
1. Provide flush single-gang box with single-gang extension ring at locations indicated.
  2. Provide one (1) 3/4-inch raceway stubbed out to nearest accessible ceiling. Include bushings at all raceway terminations.
  3. Coordinate installation with finished surfaces for flush installation.
- 3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS
- A. General:
1. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
  2. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
  3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  4. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
  5. Cut sleeves to length for mounting flush with both surfaces of walls.
  6. Seal space outside of sleeves with grout for penetrations of concrete and masonry
    - a. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
  7. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
  8. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
  9. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
  10. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  11. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

12. Where sleeves penetrate a wall with one side having exposed structure, sleeves shall be placed above the elevation of the bottom of steel. Where a roof deck elevation change occurs, sleeve height shall vary and be install above the elevation of bottom of steel on both sides of wall.
  - B. Sleeves: Provide sleeves for electronic safety and security cabling. These sleeves not shown on drawings. Each group of sleeves shall be located to minimize the length of cabling to serve the associated devices in each room or area. Provide the quantity and size of sleeves as defined:
    1. Rooms with two or less systems device rough-ins: One (1) 1-inch sleeves.
    2. Rooms with three to five systems device rough-ins: Two (2) 1-inch sleeves.
    3. Rooms with six or more systems device rough-ins: Two (2) 2-inch sleeves.
- 3.3 SLEEVE-SEAL INSTALLATION
- A. Install to seal exterior wall penetrations.
  - B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- 3.4 FIRESTOPPING
- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Section 07 84 13 "Penetration Firestopping."

END OF SECTION 28 05 00

## SECTION 28 05 13

### CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Lock power.
  - 2. Card reader.
  - 3. Door contact.
  - 4. Request to Exit.
  - 5. Network cabling.
  - 6. RS-485 cabling.
  - 7. Identification products.
- B. Related Sections:
  - 1. Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  - 2. Section 08 71 00 "Door Hardware" for electrified door hardware.
  - 3. Section 28 13 00 "Access Control" for access control system and video
  - 4. Section 28 46 00 "Fire Detection and Alarm Systems" for fire alarm cables and conductors

##### 1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- F. RCDD: Registered Communications Distribution Designer.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: If requested, for qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

##### 1.4 FIELD CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
  - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### PART 2 - PRODUCTS

- 2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - A. Belden.
  - B. General Cable.
  - C. West Penn Wire.

- D. Windy City Wire.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.3 CABLES

- A. General Cable Requirements: Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and as recommended by system manufacturer for integration requirement. Provide composite cable, CMP rated jacket with the following cable components. Provide additional individual cables to doors with multiple devices of the same type. Minimum 16 AWG conductors for lock power. Increase conductor gauge with distance per manufacturers recommendation.
- B. Lock Power:
1. Four conductor, No. 16 AWG, stranded (7x30) tinned copper conductors.
  2. Low smoke polyvinyl chloride insulation.
  3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
  4. Fluorinated ethylene propylene jacket.
  5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with NFPA 262.
  7. Color: Gray.
  8. Belden 6202UE or approved equal.
- C. Card Reader:
1. Three (3) twisted pair, shielded, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. FEP – Fluorinated Ethylene Propylene insulation.
  3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
  4. Fluorinated ethylene propylene jacket.
  5. No. 24 AWG stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with NFPA 262
  7. Color: Orange.
  8. Belden 6504FE or approved equal.
- D. Door Contact:
1. Two conductor, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Low smoke polyvinyl chloride insulation.
  3. Fluorinated ethylene propylene jacket.
  4. Flame Resistance: Comply with NFPA 262.
  5. Color: White.
  6. Belden 6500FE or approved equal.
- E. Request to Exit:
1. Four conductor, No. 22 AWG, stranded (7x30) tinned copper conductors.
  2. Low smoke polyvinyl chloride insulation.
  3. Fluorinated ethylene propylene jacket.
  4. Flame Resistance: Comply with NFPA 262.
  5. Belden 6502FE or approved equal.
- F. Network Cabling:
1. Comply with requirements in Section 27 15 00 "Communications Cabling".
- G. RS485 Cabling:
1. Two Conductor twisted pair, No. 24 AWG, stranded (7x32) tinned copper conductors.
  2. FEP – Fluorinated Ethylene Propylene insulation.
  3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
  4. Fluorinated ethylene propylene jacket.
  5. No. 24 AWG, stranded (7x32) tinned copper drain wire.
  6. Flame Resistance: Comply with NFPA 262
  7. Color: Orange.
  8. Belden 6640FD or approved equal.

## 2.4 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Brady Worldwide, Inc.
  - 2. HellermannTyton North America.
  - 3. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-C.1.
- B. Factory test UTP cables according to TIA/EIA-568-C.2.
- C. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-C.3.
- D. Cable will be considered defective if it does not pass tests and inspections.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 28 05 00 "Common Work for Electronic Safety and Security" for installation of supports for cables.

### 3.2 WIRING METHOD

- A. Install wiring in conduits, except above accessible ceilings.
  - 1. Minimum conduit size shall be ¾-inch. Control and data transmission wiring shall not share conduit with other building wiring systems.
  - 2. Comply with requirements in Section 28 05 00 "Common Work Results for Electronic Safety and Security."
- B. Install cable, concealed in cable tray above accessible ceilings, when possible.
- C. Install cable using cable supports (J-hooks) between cable tray and stub-ups above accessible ceilings. Route cables parallel and perpendicular to building structure.
- D. Wiring within Enclosures:
  - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
  - 2. Install lacing bars and distribution spools.
  - 3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
  - 4. Install conductors parallel with or at right angles to sides and back of enclosure.
  - 5. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks.
  - 6. Mark each terminal according to system's wiring diagrams.
  - 7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.



6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- D. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
1. Comply with TIA/EIA-568.
  2. Install 110-style IDC termination hardware unless otherwise indicated.
  3. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569 recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
  4. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
  5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
  6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.
- 3.4 POWER AND CONTROL-CIRCUIT CONDUCTORS
- A. Install according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits, No. 14 AWG.
  2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
  3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.
- 3.5 CONNECTIONS
- A. Comply with requirements in Division 28 Section "Access Control" for connecting, terminating, and identifying wires and cables.
- 3.6 FIRESTOPPING
- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- B. Comply with TIA-569, "Firestopping" Annex A.

- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.7 GROUNDING

- A. For communications wiring, comply with TIA-607 and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

### 3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
  - 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment, and patch cords, and labeling of all components.
  - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 28 05 13

## SECTION 28 46 3100

### FIRE-DETECTION AND ALARM SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. Manual fire-alarm pull stations.
  - 3. System smoke detectors.
  - 4. System heat detectors.
  - 5. Duct smoke detectors
  - 6. Fire alarm notification appliances.
  - 7. Remote device location-indicating lights.
  - 8. Addressable interface device.
  - 9. Digital alarm communicator transmitter.
  - 10. Device guards.
- B. Related Sections:
  - 1. Section 08 71 00 "Door Hardware."
  - 2. Section 21 10 00 "Water-Based Fire Suppression Systems."
  - 3. Section 23 33 00 "Air Duct Accessories" for smoke dampers and combination fire/smoke dampers.
  - 4. Section 26 05 53 "Identification for Electrical Systems."
  - 5. Section 26 05 33 "Raceway and Boxes for Electrical Systems."
  - 6. Section 28 05 00 "Common Work Results for Electronic Safety and Security."
- C. Included in this Section is the connection of the fire alarm system to common ducted mechanical units for shutdown upon activation of duct mounted detection on supplying mechanical unit.
- D. Included in this Section is the required connection and activation of smoke and fire smoke dampers. Method shall vary by location and be compliant with the International Building Code, the International Mechanical Code, the National Electrical Code, the National Fire Protection Association code and the Authorities having Jurisdiction.
- E. The work of this Section shall be performed by one supplying contractor who takes responsibility for the testing, Field Quality Control and overall completion of the work specified in the Contract Documents including submittals to authorities having jurisdiction.

##### 1.2 DEFINITIONS

- A. AHJ: Authorities having jurisdiction
- B. DACT: Digital Alarm Communicator Transmitter.
- C. FACP: Fire Alarm Control Panel.
- D. FAA: Fire Alarm Annunciator Panel.
- E. LED: Light-emitting diode.
- F. NAC: Notification appliance circuit
- G. NICET: National Institute for Certification in Engineering Technologies.
- H. SLC: Single Line Circuit

##### 1.3 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified, addressable system with automatic sensitivity control of smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.
- B. Audible Alarm Indication: By sounding of voice alarm messages on loudspeakers for annunciation in areas specified.
- C. Visual Alarm Indication: By xenon-strobe-type units. Units visible from a common point shall be synchronized.

1.4 SUBMITTALS

- A. General Submittal Requirements:
  - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect/Engineer.
  - 2. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified fire-alarm technician, Level III minimum.
- B. Submittals shall be combined into the fewest possible submittals, as opposed to each portion being submitted separately.
- C. Product Data: For each type of product indicated. Where more than one model or option of product is presented on data sheet, provided model and all options shall be clearly identified. Product data sheet order shall match materials list.
- D. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  - 2. Complete materials list indicating quantity, model number and description of each item. Model numbers shall match factory listed model on product data sheets.
  - 3. Include voltage drop calculations for notification appliance circuits, including spare capacity.
  - 4. Include battery-size calculations for all panels.
  - 5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 6. Include grounding schematic, amplifier power calculation, and single-line connection diagram.
  - 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of conduits. Include candela ratings and voice/alarm wattage tap settings on drawings. Submitted plans shall match scale of original contract plans provided by Architect/Engineer.
  - 8. Wiring diagrams from manufacturer differentiating clearly between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Make all diagrams specific to this Project and distinguish between field and factory wiring.
  - 9. Provide a physical layout diagram of FACP showing location of each sub assembly within the FACP. Label sub assemblies with model number and indicate function or purpose.
- E. Qualification Data: For qualified Installer.
- F. Abbreviated operating instructions for mounting at the FACP and FAA.
- G. Submit Fire Alarm Record of Completion and a signed copy of delivery receipt for materials as specified in Extra Materials section below with quantity, description and line-item listing of products.
- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
  - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  - 3. Record copy of site-specific software, including all passwords and access codes.
  - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
    - a. Frequency of testing of installed components.
    - b. Frequency of inspection of installed components.
    - c. Requirements and recommendations related to results of maintenance.
    - d. Manufacturer's user training manuals.
  - 5. Manufacturer's required maintenance related to system warranty requirements.
  - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
  - 7. Software and Firmware Operational Documentation:
    - a. Program Software Backup: On USB drive, complete with data files and a listing of passwords required for full access.
    - b. Device address list.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project. Installation shall be by personnel certified by NICET or licensed by the State of Texas Fire Marshall to sell, install and service commercial fire alarms in accordance with Texas Insurance Code.
- B. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authorities having jurisdiction.
- E. The Owner may investigate, as they deem necessary, to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- F. The Owner reserves the right to reject the proposal of any Contractor who is unqualified, has previously failed to perform properly, or complete on time, contracts of a similar nature.
- G. Provide 30 percent spare capacity on each detection, auxiliary device, annunciation, and notification circuit. Each addressable loop shall have the spare capacity for each class of device (detection and auxiliary modules) to allow the addition of devices without adding homerun cabling or hardware to the FACP.

1.6 EXTRA MATERIALS

- A. Furnish spare materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Strobe and Speaker/Strobe Units: Quantity: Two (2) of each type installed.
  - 2. Smoke Detectors: Quantity: Two (2) for photoelectric type.
  - 3. Detector Bases: Quantity: Two (2).
  - 4. Fuses: Two (2) of each type installed in the system.
- B. Include a list of extra materials—confirmed and signed by Owner’s representative—in the Operation and Maintenance Manuals.

1.7 WARRANTY

- A. Manufacturer’s Warranty: Manufacturer agrees to repair or replace fire alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
  - 1. Special Extended Warranty Period: Shall exceed four (4) years starting from the date of Substantial Completion.
    - a. If the manufacturer’s warranty commences upon the date that materials are delivered, then the manufacturer’s warranty period shall be at least five (5) years to meet the requirement stated above.
  - 2. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the warranty period.
  - 3. Warranty shall cover repair or replacement of such parts determined defective upon inspection, including the full cost of related materials and labor. Additionally, there shall be no expense to the owner due to “other-than-normal” working hours.
    - a. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer’s prior written authorization.
    - b. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied under this contract.
  - 4. System shall be included into Owner’s existing service agreement for regular or ongoing factory-authorized service of the installed system.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements by the following manufacturer, no exceptions:
1. Farenhyt by Honeywell

### **2.2 SYSTEMS OPERATIONAL DESCRIPTION**

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
  2. Heat detectors.
  3. Smoke detectors.
  4. Duct smoke detectors.
  5. Automatic sprinkler system water flow.
  6. Fire-extinguishing system operation.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
  2. Identify alarm at fire-alarm control unit and remote annunciators.
  3. Transmit an alarm signal to the remote alarm receiving station.
  4. Release fire and smoke doors held open by magnetic door holders, unless otherwise noted on drawings for release only on local detection.
  5. Activate voice/alarm communication system.
  6. Shutdown supply and return fans of designated air conditioning systems upon activation of local detection.
  7. Close smoke dampers in air ducts of designated air-conditioning duct systems upon activation of local detection.
  8. Record events in the system memory.
  9. Monitor Emergency Responder Radio System status
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of primary power at fire-alarm control unit.
  4. Ground or a single break in fire-alarm control unit internal circuits.
  5. Abnormal ac voltage at fire-alarm control unit.
  6. Break in standby battery circuitry.
  7. Failure of battery charging.
  8. Abnormal position of any switch at fire-alarm control unit or annunciator.
  9. Smoke Detector range exceeded or malfunction indication.
  10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- E. System Trouble and Supervisory Signal Actions: A Trouble or Supervisory, audible, and visible signal indication at the FACP and annunciators. Initiate transmission of system Trouble or Supervisory signal to remote central station.

### **2.3 FIRE-ALARM CONTROL UNIT**

- A. Control Unit Basis-of-Design: Farenhyt IFP-2100ECS
- B. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
    - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder.
  2. Addressable initiation devices that communicate device identity and status.
    - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
    - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
  3. Addressable control circuits for operation of mechanical equipment.

- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
    - 1. Annunciator and Display: Liquid-crystal type, 4 inch, 160x120 (1/4 VGA), minimum.
    - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
  - D. Auxiliary Controls: For testing purposes, a disconnect module or multi-function switch with visual identification via LCD or LED shall be provided to activate/disable the following relays along with giving a trouble signal until switched back to normal position:
    - 1. Mechanical units fan shutdown.
    - 2. Door release, including coiling doors and shutters.
    - 3. Damper release.
    - 4. Audible Annunciation.
    - 5. Kitchen hood Shunt-trip.
  - E. Circuits:
    - 1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.
      - a. Initiating Device Circuits: Style B.
      - b. Notification Appliance Circuits: Style Y.
      - c. Signaling Line Circuits: Style 4.
  - F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system. Includes coiling doors and shutters.
  - G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.
  - H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station. Transmit device class or group to remote receiving station.
  - I. Voice/Alarm Signaling Service: Central emergency communication system with microphones, preamplifiers, amplifiers, and tone generators provided as an integral special module that is part of fire-alarm control unit.
    - 1. Automatic, simultaneous transmission of announcements or for manual transmission of announcements by use of the central-control. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
      - a. Programmable tone and message sequence selection.
      - b. Standard digitally recorded messages for "Evacuation" and "All Clear."
      - c. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
    - 2. Status Annunciator: Indicate the status of voice/alarm speaker zone.
  - J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
    - 1. Alarm current draw of entire fire-alarm panel shall not exceed 85 percent of the power-supply module rating.
  - K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
    - 1. Batteries: Sealed, valve-regulated, recombinant lead acid.
  - L. Instructions: Computer printout mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- 2.4 INTERNET AND CELLULAR ALARM COMMUNICATOR
- A. The fire alarm control panel internal communicator allows for system status reporting to a UL Central Station as well as for local and remote up/downloading of system operating options, event history and detector sensitivity.

- B. Provide IP and/or cellular communication to a UL Central Station as required by the Owner. The Owner shall select the monitoring service, remote supervising station, or central station and be responsible for connections and monthly monitoring costs. For central station service, the installation shall be certificated or placarded by the selected central station.
- C. Communications to the Central Station shall transmit alarm, supervisory and trouble signals descriptively as defined in NFPA 72 and the AHJ, with the correct addressable device designation, identification, and location. Alarms shall not be permitted to be transmitted as a general alarm or zone condition.
- D. IP communication works over an Ethernet 10/100 Base network connection. All equipment used for the IP connection (such as a router, switch, etc.) must be powered from an un-switched branch circuit with UPS standby power.
- E. IP and cellular communication transmission shall utilize the Honeywell commercial fire communicator model HWF2-COM with metal enclosure and keylock. The HWF2-COM is an IP and cellular option for commercial fire alarm control panels and shall be NFPA 72 compliant for sole, primary, and backup communicator and programmed to operate per UL864 requirements. The communicator shall be installed per manufacturer's written instructions.
- F. The HWF2-COM shall be installed in the same room and within twenty-feet of the fire alarm control panel. The cellular provider model to be determined by the greater signal strength on site. When required provide an external antenna for signal strength optimization. Installation of the external antenna shall be per manufacturer's instruction and shall consist of the following:
  - 1. Fifty-foot antenna cable model 7626-50HC.
  - 2. 3dBA gain antenna model CELL-ANT3DB.
  - 3. SMA to N adapter model WA7626-CA.
- G. The fire alarm contractor shall provide all activation circuits and the communicator shall be ready for programming by the monitoring provider selected by the Owner. The fire alarm contractor shall coordinate with and provide all necessary information to the representative of the service provider selected by the Owner.
- H. Surge protectors for Ethernet network runs rated up to Category 6A and operating at up to 10-Gigabit data rates. Each module shall protect up all four pairs using hybrid design multi-stage SAD technology which shall automatically reset to protect against multiple surges, Ethernet surge protectors shall be
- I. Ditek DTK-CAT6A series as follows:
  - 1. DTK-110RJC6A with 110 to RJ-45 connections.
  - 2. DTK-110C6A with 110 to 110 connections.

## 2.5 NETWORK GRADE CABLING FOR DIGITAL COMMUNICATOR SERVICE

- A. Provide two parallel runs of Ethernet network grade cabling as required to support the digital communicator systems in this specification section. Category listing of the cable shall be by the Owner's and/or the Facility's current Network Standards. Extend from the drop location inside the digital communicator panel to the building Telco Demarcation Point/Main Distribution Frame location and terminate at each end in a surface mount block. Coordinate Telco or Data termination location with the owner prior to installation. Cable runs shall be tested to industry standards to verify performance.

## 2.6 FIRE ALARM FLOOR PLAN MAP

- A. Provide adjacent to the fire alarm control panel a plan view of all building areas covered by the fire alarm system meeting the following requirements:
  - 1. Framed and secured to the wall and plan covered with clear acrylic panel, SpaceAge Electronics Inc. model SSU52003 Display Frame or equivalent.
  - 2. Size plan to clearly show all required information.
  - 3. Orient building to place the entry nearest to control panel at the bottom of plan.
  - 4. "YOU ARE HERE" indicator with arrow.
  - 5. Logical alarm zones.
  - 6. Room names and numbers. (Verify with Owner)
  - 7. Show each initiating device with symbol and identification number programmed in the panel. Do not show audio/visual devices.
  - 8. Symbol legend.
  - 9. True north arrow.
  - 10. Scale indicator.



2.7 SUPPLEMENTARY NOTIFICATION APPLIANCE CIRCUIT PANELS

- A. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Notification appliances shall be powered by 24-V dc source.
  - 1. Alarm current draw of each notification appliance circuit shall not exceed 85 percent of the power supply circuit rating.
- B. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
- C. Units shall be activated and monitored by addressable modules connected to fire alarm control panel. Connection to FACP notification circuits shall not be permitted. Connection shall support disabling the audible notification separate from the visual notification.

2.8 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  - 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  - 2. Station Reset: Key operated switch.

2.9 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
  - 1. Comply with UL 268; operating at 24-V dc, nominal.
  - 2. Detectors shall be two-wire type.
  - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
  - 7. Remote Control: Unless otherwise indicated, detectors shall be addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    - c. Provide multiple levels of detection sensitivity for each sensor.
  - 8. Relays associated with smoke detectors for door hold-open or damper release shall be addressable type for control from the FACP thru the auxiliary switches. Relay bases activated only by local detector shall not be accepted. Devices shall be grouped according to type and not be combined.
  - 9. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  - 10. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).

2.10 COMBINATION CARBON MONOXIDE/SMOKE DETECTORS

- A. Provide as required by National, state and local codes, analog spot type intelligent combination smoke and carbon monoxide detector with sounder base. Farenhyt model IDP-FIRE-CO Advanced Multi-Criteria Fire/CO Detector with B200S sounder base, or equivalent.

- B. The CO detector shall be ANSI/UL 2075 Third Edition Listed and installed in accordance with IBC/IFC Section 915 and NFPA 720 requirements.
- C. Each carbon monoxide and smoke detector shall be attached to a SLC and set to a distinct address and internal identification code, which the control panel shall use to identify the location, status, and type of device.
- D. The detectors shall provide dual alarm and power/status LEDs. Status LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel.
- E. The CO sounder base shall share the address of the addressable CO detector and shall function as a single station local audible alert only when CO is detected. The audible CO alert signal shall be a Code-4/TC4 (temporal-four) audible pattern as designated by the NFPA for CO warning.
- F. Each sounder base requires 24VDC resettable power and shall be resettable from the FACP.
- G. The detector shall also provide a maintenance alert feature whereby the detector shall initiate a trouble condition should the units' sensitivity approach the outside limits of the normal sensitivity window.
- H. Except for temporary testing, detectors shall not be installed until the building is ready for occupancy and cleaned as dust free as possible.
- I. Each detector head shall be labeled in a visible area with its device hardware address utilizing self-laminating, flexible vinyl film, non-smear, machine printed labels.
- J. Required CO detector coverage to be provided as follows:
  - 1. Classrooms.

#### 2.11 DUCT SMOKE DETECTORS

- A. Description: Photoelectric type, duct-mounted smoke detector
- B. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
- C. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - 1. Primary status.
  - 2. Device type.
  - 3. Present average value.
  - 4. Present sensitivity selected.
  - 5. Sensor range (normal, dirty, etc.).
- D. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
- E. Each sensor shall have multiple levels of detection sensitivity.
- F. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- G. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit. Supervised control relay must be located within three (3) feet of the fan controller.
- H. Relays associated with duct smoke detectors for mechanical unit shutdown or damper release shall be addressable type for control from the FACP thru the auxiliary switches.

#### 2.12 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  - 1. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.13 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- B. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-(25-mm-) high letters on the lens.
  - 1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
    - b. Set candela value as indicated on the Drawings with rating visible from the exterior of the device.
  - 2. Provide weatherproof visual device where indicated.
    - a. Device to be Wheelock, Inc. #RSSWP Series or approved equal
  - 3. Mounting: Wall mounted unless otherwise indicated.
  - 4. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  - 5. Flashing shall be in a temporal pattern, synchronized with other units.
  - 6. Strobe Leads: Factory connected to screw terminals.
  - 7. Mounting Faceplate: Factory finished, red.
- C. Voice Notification Appliances:
  - 1. Appliances shall be UL listed and shall be listed and labeled by an NRTL.
  - 2. High-Range Units: Rated 2 to 15 W.
  - 3. Low-Range Units: Rated 1/4 to 2 W.
  - 4. Mounting: Semi-recessed.
  - 5. Sound Output: 84 dBA (UL 464, 24VAC) minimum. Unit shall have an integral switch to select high or low dBA level (low setting reduces output by 6 dBA).
  - 6. Combination devices consist of factory-combined, audible, and visual alarm units in a single mounting assembly.
  - 7. Ceiling mounted units shall be red and have a round, semi-recessed housing for ceiling installation. The word "FIRE" is engraved in minimum 1-inch (25-mm) high red letters on the face.

2.14 MAGNETIC DOOR HOLDERS

- A. Door hold opens furnished by Division 8.

2.15 REMOTE DEVICE LOCATION-INDICATING LIGHTS.

- A. Description: An LED-indicating light in the vicinity of each sprinkler water-flow switch and valve tamper switches denotes the associated individual device is in an abnormal or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, the room where the valve is located or the protected spaces downstream from the water-flow switch. Monitor modules shall have an individual LED indicator for each flow switch and each valve tamper switch.
- B. Description: An LED-indicating light in the vicinity of a duct detector located above an accessible ceiling or as indicated on the drawings. The LED indicates when the associated device is in an alarm or trouble mode. Lamp is flush mounted in ceiling tile below detector if applicable, otherwise wall mounted. Provide with magnetic test switch and label with unit and area served.

2.16 REMOTE ANNUNCIATOR

- A. Description: Annunciator display and functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
- B. Mounting: Flush cabinet, NEMA 250, Type 1.
- C. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals. Provide two-step drill switch.
- D. Voice Annunciation: Provide microphone and controls for voice annunciation at main panel locations. FAA Display, controls and microphone shall be housed in a common enclosure.

- E. Instructions: Provide instruction and orientation plan identical to that for the FACP except instructions are to be specific to the operation and location of the annunciator panel.

#### 2.17 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown, mechanical unit shutdown, door release, or other functions indicated.

#### 2.18 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. DACT shall be integral to the FACP.
- D. Local functions and display at the digital alarm communicator transmitter shall include the following:
  - 1. Verification that both telephone lines are available.
  - 2. Programming device.
  - 3. LED display.
  - 4. Manual test report function and manual transmission clear indication.
  - 5. Communications failure with the central station or fire-alarm control unit.
- E. Digital data transmission shall include the following:
  - 1. Group or class of the alarm-initiating device.
  - 2. Group or class of the supervisory signal.
  - 3. Group or class of the trouble-initiating device.
  - 4. Loss of ac supply or loss of power.
  - 5. Low battery.
  - 6. Abnormal test signal.
  - 7. Communication bus failure.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

#### 2.19 SURGE PROTECTION

- A. A. Each incoming 120VAC power circuit shall be provided with an electrical surge protection module. Provide one for each fire alarm control unit, this shall include every fire alarm control panel, digital communicator, signal power expander and any other 120VAC powered fire alarm control units. Each power circuit surge protector module shall be Ditek DTK-120SRD or equivalent.
- B. B. Surge protection shall be provided for all exterior devices, communications service or antenna entrance connections, and for each circuit that connects one building to another (i.e. any other portion of a building complex not under one continuous roof) at both entry/exit points to prevent damage to equipment. Each surge protector shall be UL listed and mounted in a standard grounded metallic electric box or equipment backboard with a separate ground wire ran directly to the ground bus bar or equipment panel ground stud, do not daisy chain ground wires.

#### 2.20 DEVICE GUARDS

- A. Manual Fire Alarm Pull Covers: Clear polyshield hinged cover to prevent stations from accidental operation. Provide a cover for all pull stations shown on contract drawings.
  - 1. Manufacturer: Safety Technology Inc., #STI-1200 series or approved equal.

#### 2.21 CONDUCTORS AND CABLES

- A. Fire Alarm Wire and Cable: Complying with NFPA 70, Article 760.
  - 1. Signaling Line Circuits: Twisted, shielded pair.

2. Non-Power-Limited Circuits: Solid-copper conductors, 600-V, 75 deg C.
  - a. Low-Voltage Circuits: No. 16 AWG, minimum.
  - b. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Color: Red.

### **PART 3 - EXECUTION**

#### **3.1 EQUIPMENT INSTALLATION**

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Coordinate backbox requirements with Division 26. All devices shall be installed within backboxes properly attached to building structure.
- C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- D. Smoke- or Heat-Detector Spacing:
  1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  2. Locate ceiling-mounted detectors not less than 4 inches (100 mm) from a side wall to the near edge.
  3. Wall Mounted: Locate detectors at least 4 inches (10 mm), but not more than 12 inches (300 mm), below the ceiling.
  4. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
  5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.
  6. Speakers: Locate detectors not closer than 24 inches (600 mm) from intercom or sound reinforcement speakers.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- F. Install duct smoke detector in the supply or return duct of units supplying greater than 2000 cfm per local AHJ requirements. Install duct smoke detectors in the supply and return duct of units supplying greater than 15,000 cfm.
- G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Combine audible and visual alarms at the same location into a single unit.
- J. Visible Alarm-Indicating Devices: Install at least 6 inches (150 mm) below the ceiling. Install synchronization module in circuits of devices visible from a common point.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- L. Fire-Alarm Control Unit: Recess mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
- M. Annunciator: Install with top of panel not more than 60 inches (1524 mm) above the finished floor.
- N. Fire Alarm Power Circuit Breakers: Provide red breaker or with red lockable handle or cover with FIRE ALARM indicated for each fire alarm panel or power supply panel. Identify circuit in red on panel cover. Identify electrical circuit and location of disconnect with engraved label on front of each fire alarm panel.
- O. Provide detection in all areas where remote power, control and communication devices are located.
- P. Water-Flow Detectors and Valve Supervisory Switches: Connect discrete monitor for each sprinkler valve flow switch required to be supervised. Connect discrete monitor for each valve tamper switches located at fire riser.
- Q. Devices mounted shall completely cover outlet box and any gaps around device. Install matching backplate to cover existing area or paint area to match surrounding surface. Install adapter rings for surface mounted devices.

- R. Duct detectors shall be provided by Division 28. Comply with NFPA 72 and NFPA 90A.
- S. Install addressable relay modules at each controlled door for door hold-open release on local detector alarm and auxiliary control switches.
- T. Install interface to building elevator controls for recall, notification, power monitoring and shutdown.
- U. Smoke and Fire/Smoke Dampers: Provided by Division 23 and associated duct detectors provided under Division 28. Devices connected by Division 26. Provide interlock relay control wiring to interface Fire Alarm system to damper motors. Coordinate power and control wire routine to shut dampers.
- V. Connect addressable relay module at each sound system to initiate muting of system during activation of fire alarm system.
- W. Install protective covers over all manual fire alarm pulls.

### 3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
  - 2. Alarm initiating connection to activate shunt trip power at kitchen hoods.
  - 3. Valve Supervisory Switches: Connect monitor for valve tamper switches located at fire riser.
  - 4. Supervisory connections at elevator shunt trip breaker.
  - 5. Alarm initiating connection to activate shunt trip power at elevator.
  - 6. Supervisory connections at fire suppression control panels.
  - 7. Water-flow Detectors: Connect discrete monitor for each sprinkler valve flow switch required to be supervised.
- C. Line Seizure: Route two category 6A four-pair cables in 3/4 inch raceway directly to telephone entrance demarcation. Make connection to two telephone CO lines for automatic reporting to Remote Central Station. Wire CO lines directly from demarcation point to fire alarm panel and return lines to demarcation point for connection to internal communications equipment. Coordinate and verify line seizure wiring with telephone system provider.
- D. Make connections to Distributed Antenna System as required in IBC.

### 3.3 WIRING METHODS

- A. Wiring Method: Install cables in raceways per Division 26.

### 3.4 INSTALLATION OF BOXES AND RACEWAYS

- A. Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

### 3.5 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements:
  - 1. Fire alarm cabling in all exposed areas shall be installed in conduit per Section 26 05 33 "Raceway and Boxes for Electrical Systems".
  - 2. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
  - 3. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
  - 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.
  - 5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

- C. Separation of Wires: Install in separate raceways from all other building cabling.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit and remote annunciators.
- C. Label each device with system address. Label shall be machine printed, clear adhesive tape with high contrast lettering of sufficient size to be easily readable without the use of a ladder.
- D. Identify modules and relays as to purpose or unit served.

### 3.7 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.8 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
  1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  3. Complete Voice Intelligibility Testing per NFPA 72.
  4. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  5. Test audible appliances for the private operating mode according to manufacturer's written instructions.
  6. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  7. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 46 00

## SECTION 31 00 00 EARTHWORK

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1. General Requirements, and the Drawings are collectively applicable to this Section.

#### 1.2. SUMMARY

- A. Section Includes:
  - 1. Excavating, filling, backfilling, grading, and compacting of earth at the site.
  - 2. Preparation of building pad to limits shown on plans.
  - 3. Provide and stockpile topsoil on site.
  - 4. Dewatering excavations.
- B. Related Sections:
  - 1. Section 01 45 16 – CONTRACTOR'S QUALITY CONTROL
  - 2. Section 31 10 00 – SITE CLEARING

#### 1.3. REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM D 698 Tests Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. Hammer and 12-in. Drop.
  - 2. ANSI/ASTM D2922 - Density of Soil in Place by the Nuclear Methods.

#### 1.4. SUBMITTALS

- A. Submit in accordance with SECTION 01 30 00 – ADMINISTRATIVE REQUIREMENTS.
- B. Samples: Submit a one-gallon sample and material analysis results of imported topsoil from a testing laboratory indicating compliance with these specifications. Any topsoil delivered to the site which does not comply with the approved sample shall be re-tested at the Contractor's expense and replaced.
- C. Test Reports:
  - 1. Submit copies of test reports in accordance with SECTION 01 45 16 – CONTRACTOR'S QUALITY CONTROL.
  - 2. Compaction Tests: Submit copies of compaction test reports.

#### 1.5. QUALITY ASSURANCE

- A. Laboratory Control: On site or Imported topsoil, if required, shall be inspected and tested by an independent testing laboratory.
  - 1. Testing laboratory shall make tests of the soil from the selected source to determine that it meets the specified requirements for select fill and imported topsoil.

#### 1.6. PROJECT CONDITIONS

- A. Temporary Sheeting: Shore and sheet excavations to protect utilities and to prevent cave-in. Maintain sheeting secure until permanent construction is in place. Remove sheeting as excavations are backfilled.
- B. Drainage: Provide for adequate surface drainage during construction to keep the site free of surface water without creating a nuisance in adjacent areas.
- C. Pumping: Keep the excavations free of water at all times by pumping or other means. This shall be the responsibility of the Contractor regardless of the cause, source, or nature of the water.
- D. Protection:
  - 1. Property: Protect adjoining property, including improvements out-side the limits of the work. Protect walks, curbs, and paving from damage by heavy equipment and trucks.
  - 2. Protect benchmarks.
  - 3. Protect above and below grade utilities which are to remain.
  - 4. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation. Monitor shoring system and surrounding



ground surface during construction to detect movement. If movement becomes significant, take contingency steps to brace excavation and adjacent utility lines.

## **PART 2 - PRODUCTS**

### **2.1 SOIL MATERIALS**

- A. Topsoil
  - 1. Strip topsoil from limits of grading areas, clean of grass, roots, rock and debris to a depth of 6", and stockpile for placement on all landscape and "open space" areas. Contractor shall investigate the site to his satisfaction to determine if suitable material is available on site to meet the specification for topsoil.
  - 2. Refer to landscape architect plans and specifications for additional topsoil requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Establish extent of excavation by area and elevation; designate and identify datum elevation.
- B. Set required lines and grades using a licensed surveyor.
- C. Maintain benchmarks, monuments and other reference points.

### **3.2 PREPARATION**

- A. Before starting excavation, establish location and extent of underground utilities occurring in work area.
- B. Notify utility companies sufficiently in advance to remove and relocate lines which are in way of excavation.
- C. Maintain, reroute or extend as required, existing utility lines to remain which pass through work area.
- D. Protect and support utility services uncovered by excavation.
- E. Remove abandoned utility service lines from areas of excavation; cap, plug or seal such lines and identify at grade.
- F. Accurately locate and record abandoned and active utility lines rerouted or extended on Project Record Documents.
- G. Upon discovery of unknown utility or concealed condition, discontinue affected work and notify Architect.
- H. Remove grass, weeds, roots and other vegetation from areas to be excavated, filled and graded. Fill stump holes and like small excavations with suitable material placed in lifts and thoroughly tamped.
- I. Scarify the subgrade soil of pavement areas to a minimum depth of 6 inches, recompact to a minimum of 95% Standard Proctor (ASTM D698) and to a moisture content between -1% to +3% of optimum.

### **3.3 EXCAVATION**

- A. General: Excavate to the lines, grades and sections shown on the drawings. Allow space for the construction of forms. All excavation shall be unclassified as required regardless of the condition or type of material encountered, including rock.
  - 1. Cut areas accurately to the indicated cross-sections and grades. Take care to prevent excavation below the grades indicated. Any bottoms and slopes that are undercut shall be backfilled with earth fill and compacted.
  - 2. Finish the excavating required for graded areas and building pad to a tolerance of one inch above or below the rough grade.
  - 3. Remove underground obstructions except for piping and conduit which shall be handled as specified in SECTION 01 11 00 - SUMMARY OF WORK.
- B. Over cut planting and lawn areas to allow a layer of topsoil not less than 6" thick.
- C. Maintain excavations to drain and be free of excess water. Ponding of water on site will not be permitted.
- D. Exercise extreme care in grading around existing trees. Do not disturb existing grades around existing trees except as otherwise noted. When excavation through roots is necessary, and after review by Landscape Architect, perform by hand and cut roots with sharp axe, prune trees to compensate for root loss.
- E. Fill over-excavated areas under structure bearing surfaces in accordance with Architect's direction.
- F. Do not allow construction equipment to create "pumping" of soils.

- G. Stockpile excavated clean fill for reuse where directed. Remove excess or unsuitable excavated fill from site.
- H. Over excavate existing soils in saturated conditions. Stockpile wet material. Allow drying out to take place. Mix stockpiled materials with relatively dry onsite material before recompacting.
- I. After stripping and performing necessary cuts, excavate fire lanes to an elevation that is at least 1 foot below the pavement subgrade.

### 3.4 WASTING

- A. Surplus excavated material not suitable or required for embankment fill and backfill shall be wasted off site.

### 3.5 FILL AND BACKFILL

- A. Filling: Construct compacted fills to the lines, grades and sections shown on the drawings.
  - 1. Complete stripping and wasting operations in advance of fill construction. Proof roll, compact, and establish moisture content.
  - 2. Deposit and mix fill material in horizontal layers not more than 8" deep, loose measurement. Manipulate each layer until the material is uniformly mixed and pulverized.
  - 3. Fill material shall have moisture content and compaction per Geotechnical Report. If fill is too wet, dry by aeration to achieve desired moisture content. If fill is too dry, add water and mix in by blading and discing to achieve desired moisture content.
  - 4. Exercise care to prevent movement or breakage of walls, trenches, and pipe during filling and compaction. Place fill near such items by means of light equipment and tamp with pneumatic or hand tampers.
  - 5. Proof roll exposed subgrade in building and paving areas with heavily loaded dump truck (25 ton minimum) or similar acceptable construction equipment, to detect unsuitable soil conditions. Commence proof rolling operations after a suitable period of dry weather to avoid degrading acceptable subgrade surfaces. Make four passes over each section with proof rolling equipment, with the last two perpendicular to the first two.
  - 6. Cut out soft areas of subgrade not readily capable of in- situ compaction. Backfill and compact to density equal to requirements for subsequent backfill material.
- B. Backfilling: Construct compacted fill against and around concrete beams below finish grade.
  - 1. Verify areas to be backfilled are free of debris, snow, ice or water, and ground surfaces are not frozen.
  - 2. Do not backfill until underground construction has been inspected, tested and approved, forms removed, and the excavations cleaned of trash and debris.
  - 3. Bring backfill to required grades by depositing material in horizontal layers not more than 8" deep, loose measurement.
  - 4. Site backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet or spongy subgrade surfaces.
  - 5. Maintain optimum moisture content of backfill materials to attain required compaction density.
  - 6. Make gradual changes in grade. Blend slopes into level areas.

### 3.6 COMPACTION

- A. Compact each layer of earth fill and backfill to the compaction and density specified.
  - 1. Scarify the subgrade soil of pavement areas to a minimum depth of 6 inches, recompact to 93%-98% Standard Proctor (ASTM D698) and to a moisture content between +2% and +6% above optimum for clayey soils with PI equal to or greater than 25. Scarify the subgrade soil of pavement areas to a minimum depth of 6 inches, recompact to a minimum of 95% Standard Proctor (ASTM D698) and to a moisture content between -1% and +3% above optimum for clayey soils with PI less than 25.
  - 2. Equipment for compacting shall be sheeps foot and rubber tired rollers or other compactors capable of obtaining the required density. Compact the fill with power tampers and by hand in areas not accessible to rollers.
  - 3. Compact each layer of fill to the density listed below as a function of the location and depth. The required density in each case is indicated as a percentage of the maximum dry unit weight determined using the standard compaction test ASTM D 698.
    - a. Material under paving (PI $\geq$ 25) ----- 93%-98%.
    - b. Material under paving (PI $<$ 25) ----- 95% min.
    - c. Material under lawn areas (PI $\geq$ 25) ----- 93%-98%.
    - d. Material under lawn areas (PI $<$ 25) ----- 95% min.
    - e. Material under building----- Per Geotechnical Report

### 3.7 GRADING

- A. Site Grading: Shape and finish earthwork to bring the site to the finish grades and elevations shown on the drawings.
  - 1. Establish grades by means of grade stakes placed at corners of units, at abrupt changes of grade, and elsewhere as may be required.
  - 2. Rough grade for paving, and site improvements to the subgrade elevations required. Soft and unstable material which will not readily compact when rolled or tamped shall be removed and the resulting depressions filled with stable material and re-compacted.
  - 3. Finish grade to the finish contours and spot grades shown. Extend cuts and fills to feather out beyond the last finish contour or spot grade shown. Grade to uniform levels and slopes between points for which elevations are given, round off abrupt changes in elevation, and finish off smoothly. Finish grades shall slope away from the building in all directions to assure proper drainage.
  - 4. Execute erosion control measures in accordance with the Erosion Control Plan.
- B. Grading Around Trees: Where grading is required within the branch spread of trees that are to remain, perform the work as follows:
  - 1. When trenching occurs, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by hand digging.
  - 2. When the existing grade at a tree is below the new finished grade, and fill not exceeding 6" is required, clean washed gravel graded from 1" to 2" size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18" and finish approximately 2" above the finished grade at the tree. Install gravel before earth fill is placed.
  - 3. Trees in areas where the new finished grade is to be lowered shall have re-grading work done by hand to elevation as indicated. Existing grades immediately surrounding the trunk shall not be altered except at the direction of the Architect.

### 3.8 PROTECTION, CLEAN-UP AND EXCESS MATERIALS

- A. Protect grades from construction and weather damage, washing, erosion and rutting, and repair such damage that occurs.
- B. Correct any settlement below established grades to prevent ponding of water.
- C. At locations where concrete or other foreign matter has penetrated or been mixed with earth, remove damaged earth and replace with clean material.
- D. Remove excess stockpiled material, debris, waste, and other material from site and leave work in clean finished condition for final acceptance. Contractor is responsible for disposal of debris and excess materials.

### 3.9 FIELD QUALITY CONTROL

- A. Compaction Tests: Field density testing shall be performed by an Independent Testing Laboratory.
  - 7. Testing laboratory shall make one in place density test for each 5,000 sq. ft. of area per lift in general site and paving areas and one test per 100 linear feet of drive lanes, but in no case less than two tests to ensure that the specified density is obtained. In sidewalk areas, laboratory shall make one in place density test per 100 linear feet.
  - 8. The cost of the full-time inspection service shall be per Specification SECTION 01 4516 – CONTRACTOR'S QUALITY CONTROL.

### 3.10 CONSTRUCTION STAKING

- A. All drives must be staked using the profiles provided in the plans in addition to the grading and dimensional control plans. The contractor shall stake all vertical curves and points of grade break in order to achieve a smooth and uniform grade throughout. Verify all grades and elevations to confirm that ADA parking spaces, walks and ramps are per plans.

**END OF SECTION**

## SECTION 31 10 00

### SITE CLEARING

#### PART 1 - GENERAL

##### 1.1. RELATED DOCUMENTS

- A. Provisions established within the General and Supply General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

##### 1.2. SUMMARY

- A. Section Includes: Clearing the site of vegetation, site improvements and obstructions to make way for new work.
- B. Related Sections
  - 1. Section 31 00 00 - EARTHWORK.

##### 1.3. PROJECT CONDITIONS

- A. Existing Conditions: Site is generally vacant with native vegetation. Contractor shall visit the site and verify the nature and extent of clearing work required.
- B. Protection: Contractor shall be responsible for the protection of adjoining property and improvements outside the limits of the work. Protect paving and utilities from damage by equipment and trucks.
- C. It shall be the responsibility of the Contractor to obtain a temporary water meter and temporary sanitary sewer facilities for use during construction.
- D. Contractor shall exercise care during operations to confine dust to the immediate work area and shall employ dust control measures to ensure adequate dust control throughout demolition and construction operations.

##### 1.4. REGULATORY REQUIREMENTS

- A. Conform to applicable building code for disposal of debris.
- B. Coordinate clearing Work with previous owner and utility companies.
- C. Conform to applicable portions of OSHA, including 1926.604.

#### PART 2 - PRODUCTS

Not Applicable.

#### PART 3 - EXECUTION

##### 3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are tagged or identified
- B. Locate and identify all paving and utilities intended to remain. Contractor shall field verify and coordinate with Owner and respective facility owner the location and depth of existing active facilities/ utility lines within the construction limits and shall protect all such facilities from damage during construction operations. Damage to existing facilities to remain shall be repaired at the Contractor's expense for re-establishing the facilities to their pre-damaged condition.

##### 3.2 PERFORMANCE

- A. Clearing:
  - 1. Remove trees, shrubs and other vegetation from within the area of the site where new construction is to be placed. Grub out roots to a depth of at least 18 inches below natural grade
  - 2. Dig out and remove buried obstructions to a depth of 24 inches below natural grade or 24 inches below the intended excavation elevation, whichever is lower. (Refer to landscape architect's plans and specifications)
  - 3. Remove existing trash, debris and abandoned facilities, which are to be removed from the site.
  - 4. Refer to SECTION 01 11 00 - SUMMARY OF WORK for handling of piping and conduit encountered below grade.
  - 5. Clear undergrowth and deadwood, without disturbing subsoil.
  - 6. Burning debris on site is not permitted.
  - 7. Remove debris, rock, fences, and extracted plant life from site.

- B. Reference landscape plans and specifications for limits for tree removal and pruning/trimming limits.
- C. Disposal:
  - 1. Clean up and remove from the site the stumps, logs, broken paving, rubble and debris resulting from the clearing and grubbing operations.
  - 2. Remove all traces of demolished items from the site work area and rough grade all areas that have been disturbed.
  - 3. Material to be wasted shall be legally disposed of off site, at no additional cost to Owner.
  - 4. Burning of combustible materials on the site will not be permitted.

### **3.3 TOPSOIL EXCAVATION**

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or regraded.
- B. Stockpile in a preapproved area on or near the site. Install erosion control around perimeter of stockpile.
- C. Reference landscape architectural plans and specifications for additional top soil requirements.

**END OF SECTION**

## SECTION 31 23 33

### TRENCHING AND BACKFILLING

#### PART 1 - GENERAL

##### 1.1. RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

##### 1.2. SUMMARY

- A. Work Included:
  - 1. Excavation for piped utility material.
  - 2. Provide necessary sheeting, shoring, and bracing.
  - 3. Comply with Federal, State, and local trench safety requirements.
  - 4. Prepare trench bottom with appropriate materials.
  - 5. Dewater excavation as required.
  - 6. Place and compact granular beds, as required, and backfill.
- B. Related Work Specified in Other Sections
  - 1. Section 31 00 00 – EARTHWORK
  - 2. Section 31 10 00 – SITE CLEARING
  - 3. Section 33 30 00 – SANITARY SEWERAGE UTILITIES
  - 4. Section 33 40 00 – STORM DRAINAGE UTILITIES

##### 1.3. PRECAUTIONS

- A. Contractor shall determine the exact location of all utilities prior to construction.
- B. Notify all utility companies when necessary to disturb existing facilities and abide by their requirements for repairing and replacing.
- C. Protect all vegetation and other features to remain.
- D. Protect all benchmarks and survey points.

##### 1.4. COORDINATION

- A. Where the specifications conflict with the City/County Water and Sewer Specification and City/County Standard Details for water and sewer construction, the Details and Specifications shall govern in that order.

#### PART 2 - PRODUCTS

##### 2.1. BEDDING AND BACKFILL MATERIALS (ASTM D2487)

- A. Reference Sitework Details and City/County Standard Specifications. Reference site drainage plan and NCTCOG Specification for storm drainage.

#### PART 3 - EXECUTION

##### 3.1. PREPARATION

- A. Install barriers and other devices to protect areas adjacent to construction and to provide for public safety.
- B. Protect and maintain all benchmarks and other survey points.

##### 3.2. EXCAVATION TRENCHES

- A. Perform in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.
- B. Maximum width at the crown of the pipe shall be sixteen (16") inches plus the bell diameter of the pipe, unless approved specifically by the engineer due to unusual bracing and shoring requirements. The minimum width at the crown at the pipe shall be one foot plus the pipe bell diameter.
- C. Cut pavement along neat straight lines with either a pavement breaker or pavement saw.

- D. Trench Depth: For water lines - sufficient to provide minimum cover of 42 inches over the top of the pipe; for sewer lines and storm drain lines - as shown on the plans or as specified.
  - E. Align trench as shown on the plans unless a change is necessary to miss an unforeseen obstruction. Should such a change be necessary, the as-built information shall be provided to the engineer and it shall be approved by the engineer.
  - F. For water pipe, the trench shall be cut six (6") inches below the bottom of the pipe. The pipe shall be embedded in six (6") inches of granular material all around.
  - G. For sewer pipe, excavate six (6") inches below the bottom of pipe and fill the bottom of the trench with crushed stone or as specified by the City/County Standard Water & Sewer Specifications.
  - H. Trenches for storm drainage pipe shall be excavated and backfilled as shown on the plans.
  - I. When unsuitable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline and backfill to the proper grade with coarse aggregate AASHTO M-43, Size No. 2 or 3.
  - J. Remove rock encountered in trench excavation to a depth of six (6") inches below the bottom of the pipe barrel, backfill with an approved material, and compact to uniformly support the pipe. In no cases shall solid rock exist within six (6") inches of the finished pipeline.
  - K. When rock borings or soundings are provided, they are for information only and do not guarantee existing conditions. Make such investigations as deemed necessary to determine existing conditions. All trench excavation shall be considered "unclassified excavation", with no additional compensation.
- 3.3. SHEETING, SHORING AND BRACING
- A. All trench excavation shall be in accordance with OSHA Regulations and Texas State law.
- 3.4. USE OF EXPLOSIVES
- A. The use of explosives on this project is strictly prohibited.
- 3.5. DISPOSAL OF EXCAVATED MATERIAL
- A. All excess excavated material that cannot be used, or is not suitable, shall be disposed of in a manner acceptable to the Architect, at no additional cost to owner.
- 3.6. UNAUTHORIZED EXCAVATION
- A. No excavation outside or below the proposed lines and grades shown on the plans shall be provided unless approved by the Architect / Engineer.
  - B. Backfill areas of unauthorized excavation with the type material necessary (earth, rock or concrete) to ensure the stability of the structure or construction involved.
- 3.7. REMOVAL OF WATER
- A. Keep excavated areas free of water while work is in progress.
  - B. Take particular precautions to prevent the displacement of structures or pipelines as a result of accumulated water.
  - C. Discharge from dewatering activities shall not be made to any sanitary sewer system unless approved by the system operator.
- 3.8. OBSTRUCTIONS
- A. Obstructions shown on the plans are for information only and do not guarantee their exact locations nor that other obstructions are not present. The contractor shall determine and verify the exact location of all obstructions and utilities prior to construction.
  - B. When utilities or obstructions are not shown on the plans but are present off the roadway at the location of the proposed pipeline route, the contractor may request to relocate the pipeline at no additional cost to the Owner in the roadway if necessary to avoid disturbing the utility or obstructions.
  - E. Exercise due care in excavating adjacent to existing obstructions and do not disturb same.
  - D. In the event obstructions are disturbed, repair or replace as quickly as possible to the condition existing prior to their disturbance. The repair or replacement shall be at no cost to the Owner.

- E. If desired by the utility company, pay for the repair or replacement work performed by the forces of the utility company or other appropriate party.
  - F. If replacement or repair of disturbed obstructions is not performed after a reasonable period of time, the Owner may have the necessary work done and deduct the cost of same from payments to the contractor.
- 3.9. STORM SEWER BEDDING
- A. Bedding for RCP/HDPE storm sewers shall be as specified in Section 501.6, 504 and 504.2.1 thru 504.2.3 of Standard Specifications for Public Works Construction, NCTCOG and site details.
- 3.10. GRAVITY SANITARY SEWER BEDDING
- A. Always maintain proper grade and alignment during the bedding and tamping process.
    - 1. Any pipe dislodged during this process shall be replaced by the contractor at his expense.
    - 2. Dig bell holes to assure uniform support of the pipe.
    - 3. All bedding shall be tamped to a minimum of 95% maximum dry density.
  - B. Bedding for PVC Sewers:
    - 1. Refer to Sitework Details and Standard Water and Sewer Specifications.
    - 2. Lay sewer line on six inch (6") bed of crushed stone. Place granular material to a point twelve inches (12") above top of pipe.
- 3.11. BEDDING FOR WATER LINES
- A. The water line shall be bedded on six (6") inches of granular material in accordance with City/County Water and Sewer Specifications. Compact granular material to a point six inches (6") above the top of pipe.
  - B. Dig bell holes to assure uniform support throughout the entire length of pipe.
- 3.12. INITIAL BACKFILLING
- A. Do not begin backfilling before checking/inspecting the grade and alignment of the pipe, the bedding of the pipe, and the joints between the pipe. If backfill material is placed over the pipe before an inspection is made, reopen the trench in order for an inspection to be made.
  - B. Perform backfilling by hand, together with tamping, until fill has progressed to the top of specified embedment above the pipe.
    - 1. Deposit appropriate material free from lumps, clods, frozen material or stones in layers approximately eight (8") inches thick.
    - 2. Compact by hand, or with manually operated machine tampers actuated by compressed air or other suitable means.
    - 3. Use tamps and machines of a suitable type which do not crush or otherwise damage the pipe.
- 3.13. FINAL BACKFILLING
- A. After placement of the granular embedment material has been achieved, perform final backfilling depending upon the location of the work and danger from subsequent settlement.
  - B. Backfilling beneath existing or proposed driveways, streets, sidewalks, parking areas or any paved area:
    - 1. Backfill trenches per Geotechnical Report.
    - 2. Carefully deposit in uniform layers, not to exceed six (6") inches thick.
    - 3. Compact each layer by rolling, ramming and tamping with tools suitable for that purpose in such a manner so as to not disturb the pipe.
    - 4. At 200' intervals in the trench, clay check dams shall be installed to inhibit the piping of surface and/or subsurface water. The contractor shall compact full depth two foot (2') clay check dams at each location the trench enters or exits a pavement.
    - 5. Jetting or ponding of native material backfill will not be allowed.
- 3.14. FIELD QUALITY CONTROL
- A. Compaction Tests: Field density testing of the completed trench backfill shall be performed by an Independent Testing Laboratory.
    - 1. The Laboratory shall make one density test for each 150 linear feet of trench, with a minimum of 1 test per lift.

**END OF SECTION**



## SECTION 313116

### TERMITE CONTROL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Soil treatment.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
  - 2. Include the EPA-Registered Label for termiticide products.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of termite control product.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
  - 1. Date and time of application.
  - 2. Moisture content of soil before application.
  - 3. Termiticide brand name and manufacturer.
  - 4. Quantity of undiluted termiticide used.
  - 5. Dilutions, methods, volumes used, and rates of application.
  - 6. Areas of application.
  - 7. Water source for application.
- D. Sample Warranties: For special warranties.

##### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

##### 1.6 FIELD CONDITIONS

- A. Soil Treatment:
  - 1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
  - 2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

##### 1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (*Coptotermes formosanus*). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain termite control products from single source from single manufacturer.

### **2.2 SOIL TREATMENT**

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Corporation, Agricultural Products; Termidor.
    - b. Bayer Environmental Science; Premise 75.
  - 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
  - 1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

### **3.3 APPLYING SOIL TREATMENT**

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
  - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
  - 2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
  - 3. Crawlspace: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
  - 4. Masonry: Treat voids.
  - 5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.
- B. Post warning signs in areas of application.
- C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 PROTECTION

- A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.5 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include quarterly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
  - 1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 31 32 00

### SOIL STABILIZATION

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

##### 1.2 SUMMARY

- A. Section Includes: In-place lime treatment to stabilize the subgrade under concrete and asphaltic concrete pavement, and concrete walks, which parallel drives.
- B. Related Sections:
  - 1. Section 01 45 29 – TESTING AGENCY SERVICES
  - 2. Section 31 00 00 – EARTHWORK
  - 3. Section 32 13 13 – CONCRETE PAVING

##### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM D698-91 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup>).
- B. Geotechnical Report ALPHA No. G240443
- C. TxDOT - Standard Specifications for Construction of Highways, Streets and Bridges, Texas Dept. of Highways and Public Transportation, as amended.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Lime - Stabilization for Paving Subgrade
  - 1. Per TxDOT Item 260.
- B. Soil: Upper 6" of the material in-place after the subgrade has been established, compacted, and shaped.
- C. Lime: Hydrated lime made from "high calcium" type limestone with an unhydrated lime content a minimum of 8% by weight at 36 lbs per square yard for a treated depth of 6". Waste lime will not be acceptable.

##### 2.2 EQUIPMENT

- A. Distributor truck or tank equipped with agitator to maintain a uniform mixture of lime and water.

#### PART 3 - EXECUTION

##### 3.1 PREPARATION

- A. Ensure that surfaces have been brought to approximate rough grades (plus or minus 0.10 feet). In areas of 6 inch pavement, loosen and pulverize soil to a depth of 6 inches below bottom of designated paving or slab areas, including a distance of 24" outside perimeter of paving and 24" past sidewalk per the plans.
- A. General: It is the primary requirement to secure a completed 6" (in areas of 6" pavement) deep subgrade of treated material containing a uniform lime mixture, free of loose areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent paving and slabs. Construction methods and equipment shall comply to TxDOT Item 260.
- B. Scarification: Excavate and scarify the material to be treated down to the secondary grade (proposed bottom of lime treatment). Wet or unstable material below the secondary grade shall be corrected by scarifying, adding lime and compacting to uniform stability. Then spread the excavated and scarified material to the desired cross-section. Full depth of treatment shall be 6 inches in areas of 6 inch pavement and full width shall be the entire area to be paved between points and lines located a minimum of 24" beyond pavement edges and 24" beyond sidewalk edge or per the plans, whichever is greater.

- C. Placing Lime: Add lime to the scarified material in an amount equal to 36 lbs per sq. yd. of 6" depth. Apply lime mixed with water to form a slurry. Spread lime only on that area where mixing operations can be completed during the same working day.
- D. Mixing: Mix the soil and lime thoroughly with suitable road mixers or other approved equipment until a homogeneous, friable mixture is obtained free from clods and lumps. Aerate or sprinkle the mixture as necessary to secure the optimum moisture content. Necessary optimum moisture content shall be above optimum.
- E. Curing: Allow the mixture to cure for a period of from 48 to 72 hours. During the curing period keep the material moist. During this time, the section shall not be opened to vehicular traffic.
- F. Final Mixing: After the required curing time, mix the material uniformly with a rotary mixer to reduce the size of the particles so that 100% will pass a 1-3/4" sieve and 60% will pass a No. 4 sieve.
- G. Compacting: Sprinkle the mixture as required and compact by rolling and tamping to a minimum of 95% standard density, ASTM D698, and at a moisture content above optimum. Correct irregularities and weak spots by scarifying, adding or removing material, and re-shaping and re-compacting. Maintain the surface of the subgrade smooth, free from undulations and ruts, and to the established lines and grades.

### 3.2 FIELD QUALITY CONTROL

- A. Compaction Tests: Field density testing of the completed stabilized subgrade under paving shall be performed by an Independent Testing Laboratory.
  - 1. The Laboratory shall make one density test for each 5,000 sq. ft. of stabilized subgrade in paving areas and one test per 100 liner feet of drives to ensure that the specified density is obtained.

**END OF SECTION**

## SECTION 31 63 29

### DRILLED CONCRETE PIERS AND SHAFTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Dry-installed drilled piers.

##### 1.2 UNIT PRICES

- A. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, cable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments are made on net variation of total quantities, based on design dimensions for shafts.
  - 1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft.
  - 2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.
- B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed outside dimensions of drilled piers cast against rock. Unit prices for rock excavation include replacement with approved materials.
- C. Trial Drilled Pier: Same unit price as indicated for drilled pier, including backfilling.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to drilled piers including, but not limited to, the following:
    - a. Review geotechnical report.
    - b. Discuss existing utilities and subsurface conditions.
    - c. Review coordination with temporary controls and protections.
    - d. Review measurement and payment of unit prices.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Shop Drawings: For concrete reinforcement, detailing fabricating, bending, supporting, and placing.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer
- B. Welding certificates.
- C. Material Certificates: From manufacturer, for the following:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Steel reinforcement and accessories.
- D. Material Test Reports: For each material below, by a qualified testing agency:
  - 1. Aggregates:
- E. Field quality-control reports.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Record drawings.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.
- B. Testing Agency Qualifications: Qualified according to ASTM C1077, ASTM D3740, and ASTM E329 for testing indicated.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.8 TRIAL DRILLED PIER

- A. Trial Drilled Pier: Construct trial drilled pier of diameter and depth and at location indicated or, if not indicated, of same diameter and depth as largest drilled piers, located at least three diameters clear of permanent drilled piers, to demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.
  - 1. Install reinforcement, fill with concrete, remove temporary casings, and terminate trial drilled pier 24 inches below subgrade and leave in place.
  - 2. Install casing if required, excavate rock socket, and place slurry, as required for permanent drilled piers.
  - 3. If Architect determines that trial drilled pier does not comply with requirements, excavate for and cast another until it is accepted.

1.9 FIELD CONDITIONS

- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
  - 1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
- B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without Owner's written permission.
- C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
  - 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
- D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
  - 1. Record and maintain information pertinent to each drilled pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Drilled-Pier Standard: Comply with ACI 336.1 except as modified in this Section.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Plain and Deformed Steel Wire: ASTM A1064/A1064M,.
- D. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain. Cut bars true to length with ends square and free of burrs.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C150/C150M, Type I/II.
    - a. Fly Ash: ASTM C618, Class C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
  - 2. Blended Hydraulic Cement: ASTM C595/C595M, cement.
- B. Normal-Weight Aggregate: ASTM C33/C33M, graded,
  - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C94/C94M
- D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
  - 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
  - 4. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
  - 5. .
- E. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type II; clean natural sand, ASTM C404; and water to result in grout with a minimum 28-day compressive strength of 1000 psi, of consistency required for application.

## 2.4 STEEL CASINGS

- A. Steel Pipe Casings: ASTM A283/A283M, Grade C, or ASTM A36/A36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.
- B. Corrugated-Steel Pipe Casings: ASTM A929/A929M, steel sheet, zinc coated.
- C. Liners: Comply with ACI 336.1.

## 2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Proportion normal-weight concrete mixture as follows:
  - 1. Compressive Strength (28 Days): per Drawings.
  - 2. Maximum Water-Cementitious Materials Ratio: per Drawings.
  - 3. Minimum Slump: Capable of maintaining the following slump until completion of placement:
    - a. 4 inches for dry, uncased, or permanent-cased drilling method.
    - b. 6 inches for temporary-casing drilling method.
    - c. 7 inches for slurry displacement method.
  - 4. Air Content: Do not air entrain concrete.

## 2.6 REINFORCEMENT FABRICATION

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.



### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

#### **3.2 EXCAVATION**

- A. **Unclassified Excavation:** Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
  - 1. **Obstructions:** Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time are authorized for removal of obstructions.
  - 2. **Obstructions:** Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.
- B. **Classified Excavation:** Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:
  - 1. **Standard excavation** includes excavation accomplished with conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.
  - 2. **Special excavation** includes excavation that requires special equipment or procedures where drilled-pier excavation equipment used in standard excavation, operating at maximum power, torque, and downthrust, cannot advance the shaft.
    - a. Special excavation requires use of special rock augers, core barrels, air tools, blasting, or other methods of hand excavation.
    - b. Earth seams, rock fragments, and voids included in rock excavation area are considered rock for full volume of shaft from initial contact with rock.
  - 3. **Obstructions:** Payment for removing unanticipated boulders, concrete, masonry, or other subsurface obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.
- C. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
- D. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
  - 1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
  - 2. Remove water from excavated shafts before concreting.
  - 3. Excavate rock sockets of dimensions indicated.
  - 4. Cut series of grooves about perimeter of shaft to height from bottom of shaft, vertical spacing, and dimensions indicated.
- E. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
  - 1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
  - 2. Payment for additional authorized excavation is according to Contract provisions for changes in the Work.
- F. **End-Bearing Drilled Piers:** Probe with auger to a depth below bearing elevation, equal to diameter of the bearing area of drilled pier. Determine whether voids, clay seams, or solution channels exist.
  - 1. Test first three drilled piers and one of every six drilled piers thereafter.
  - 2. Fill augur-probe holes with grout.
- G. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.
- H. **Temporary Casings:** If required, install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
  - 1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

- I. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
  - 1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

### 3.3 STEEL REINFORCEMENT INSTALLATION

- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

### 3.4 CONCRETE PLACEMENT

- A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by a qualified testing agency.
  - 1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.
- B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.
  - 1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
  - 2. Vibrate top 60 inches of concrete.
- C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
  - 1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.
- D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
  - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.
  - 1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Drilled piers.
  - 2. Excavation.
  - 3. Concrete.
  - 4. Steel reinforcement welding.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
  - 1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities are determined by testing and inspecting agency. Final evaluations and approval of data are determined by Architect.
    - a. Bearing Stratum Tests: Testing agency takes undisturbed rock core samples from drilled-pier bottoms; tests each sample for compression, moisture content, and density; and reports results and evaluations.
- D. Concrete Tests and Inspections: ASTM C172/C172M except modified for slump to comply with ASTM C94/C94M.
  - 1. Slump: ASTM C143/C143M; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
  - 2. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and 80 deg F and above, and one test for each set of compressive-strength specimens.
  - 3. Compression Test Specimens: ASTM C31/C31M; one set of four standard cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
  - 4. Compressive-Strength Tests: ASTM C39/C39M; one set for each drilled pier but not more than one set for each truck load. Test one specimen at seven days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
  - 5. If frequency of testing provides fewer than five strength tests for a given class of concrete, conduct tests from at least five randomly selected batches or from each batch if fewer than five are used.
  - 6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor is to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
  - 7. Strength of each concrete mixture is satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
  - 8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
  - 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but not be used as sole basis for approval or rejection of concrete.
  - 10. Additional Tests: Testing and inspecting agency to make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.
    - a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
  - 11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
  - 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports for each drilled pier as follows:
  - 1. Actual top and bottom elevations.
  - 2. Actual drilled-pier diameter at top and bottom.
  - 3. Top of rock elevation.
  - 4. Description of soil materials.
  - 5. Description, location, and dimensions of obstructions.
  - 6. Final top centerline location and deviations from requirements.
  - 7. Variation of shaft from plumb.
  - 8. Shaft excavating method.
  - 9. Design and tested bearing capacity of bottom.
  - 10. Depth of rock socket.
  - 11. Levelness of bottom and adequacy of cleanout.

12. Properties of slurry and slurry test results at time of slurry placement and at time of concrete placement.
13. Ground-water conditions and water-infiltration rate, depth, and pumping.
14. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
15. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
16. Date and time of starting and completing excavation.
17. Inspection report.
18. Condition of reinforcing steel and splices.
19. Position of reinforcing steel.
20. Concrete placing method, including elevation of consolidation and delays.
21. Elevation of concrete during removal of casings.
22. Locations of construction joints.
23. Concrete volume.
24. Concrete testing results.
25. Remarks, unusual conditions encountered, and deviations from requirements.
- 26.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

**SECTION 32 13 13**  
**CONCRETE PAVING**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.2 SUMMARY

- A. Section Includes: New concrete walks, curbs and gutters, paving, approaches, and other concrete flatwork outside the building.
- B. Related Sections:
  - 1. Section 31 00 00 - EARTHWORK

1.3 REFERENCES

- A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
- B. ACI 305 - Recommended Practices for Hot Weather Concreting.
- C. ACI 306 Recommended Practices for Cold Weather Concreting.
- D. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
- E. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- F. ASTM C309, Type II – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- G. NCTCOG - Standard Specifications for Public Works Construction.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Obtain materials from same source throughout.
- C. City Standards: Street sidewalks, curbs and gutters, and approaches shall be constructed to meet or exceed the requirements of the City standard specifications (or NCTCOG) where the City standards are applicable.

1.5 SUBMITTALS

- A. Product Data: Submit concrete mix designs in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Include data on joint filler, admixtures and curing compounds.
- C. Submit manufacturer's instructions under provisions of SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Confirm proposed joint layout shown on plans; submit revised layout for approval prior to starting work.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place pavement when base surface or ambient temperature is less than 40 degrees F, or if base surface is wet or frozen.

**PART 2 - PRODUCTS**

2.1 MATERIALS

- A. Portland Cements: ASTM C 150, Type I, domestic manufacture.
- B. Fly Ash: ASTM C 618, Class F or C.
- C. Fine Aggregate: ASTM C 33, washed sand with a fineness modulus of between 2.50-3.00.

- D. Coarse Aggregate: ASTM C 33, clean crushed stone or washed gravel. The nominal maximum particle size shall not exceed 1/5 of the narrowest dimension between forms or 3/4 of the minimum clear spacing between reinforcing bars.
  - E. Admixture: ASTM C 494, Types "A", "D" and "E", water reducing, chloride-free admixture.
  - F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
  - G. Water: ASTM C 94, Clean and potable.
  - H. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  - I. Formwork:
    - 1. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
    - 2. Use flexible or curved forms for curves of a radius 100 feet or less.
    - 3. Use forms of size and strength to resist movement during concrete placement.
    - 4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
  - J. Reinforcement:
    - 1. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
    - 2. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs. Provide with closed sleeves at one end to allow one inch movement.
    - 3. Tie Bars: ASTM A 615, Grade 60, deformed.
    - 4. Bar Supports: chairs for spacing, supporting, and fastening reinforcement bars, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from plastic to support bars at the proper depth per the details.
  - K. Concrete shall meet the requirements specified in plans and specification. Paving and shall be 6 sack of cement content per cubic yard with a minimum compressive strength of 3500 psi at 28 days and 3500 psi at 28 days for flatwork. (Entrained Air: 4-6%, Slump: 4-6 inches, Fly Ash Replacement – 20% max).
  - L. Expansion Joint Filler:
    - 1. ASTM D 1751 preformed strips of asphalt saturated cane fiberboard for joints in standard finished flatwork (walks, curbs and gutters).
    - 2. ASTM D 1752, Type I preformed strips of elastic sponge rubber compound for joints to be caulked with sealant and joints in architectural concrete flatwork.
    - 3. The use of redwood expansion joints is prohibited.
  - M. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.  
Product manufacturer; one of the following:
    - Crafco Inc.; RoadSaver Silicone SL.
    - Dow; DOWSIL 890-SL
  - N. Joint Sealant Backer Rod:
    - 1. Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
    - 2. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- 2.2 MIXING AND DELIVERY
- A. Measurement of concrete materials, mixing, and delivery of fresh concrete to the project shall meet the requirements of ASTM C 94. Transit-mixed concrete supplier shall have a plant with sufficient capacity and transportation facilities to assure continuous delivery at the rate required.
  - B. Mix concrete in accordance with ASTM C94, Alternative No. 2, or ACI 304.
  - C. Deliver concrete in accordance with ASTM C94.
  - D. Select proportions for normal weight concrete in accordance with ACI 301 Method 1. Mix not less than one minute after materials are in mixer.
  - E. Do not transport or use concrete after 90 minutes has expired from time of initial mixing.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Verify compacted subgrade is ready to support paving and imposed loads, free of frost, smooth and properly compacted.
- B. Verify gradients and elevations of base are correct, and proper drainage has been provided so that water does not stand in the area to receive paving.
- C. Beginning of installation means acceptance of existing conditions.

#### **3.2 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Architect, Owner, and testing laboratory, minimum 24 hours prior to commencement of concreting operations.
- C. Grade Control: Establish and maintain the lines and grades for concrete site work items by means of line and grade stakes. Complete any fine grading required to prepare the subgrade. Maintain the finished subgrade cushions in a satisfactory condition.

#### **3.3 INSERTS AND ACCESSORIES**

- A. Make provisions for installation of inserts, accessories, anchors, and sleeves.

#### **3.4 INSTALLATION**

- A. Forming: Set forms to lines and grades, and brace and secure to withstand wet concrete without deflection or leakage. Stake forms securely in position with joints keyed to prevent relative displacement. Clean and oil forms each time they are used. Refer to Section 03 11 00 for additional installation requirements.
  - 1. Walks surfaces shall be crowned or sloped to drain:
    - a. 4" thick
    - b. 6" thick
  - 2. Curbs and Gutters: As detailed.
  - 3. Paving, Drive Approaches: Thicken edges as required.
    - a. 7" thick
- B. Reinforcing: Install reinforcing to meet the requirements of SECTION 03 20 00 - CONCRETE REINFORCEMENT. Where reinforcement is not specifically detailed, reinforce pavement with #3 rebars at 18" o.c. each way. Reinforcement for fire lane paving shall be #3 bars at 18" o.c. each way.
- C. Concrete: Place concrete to meet the requirements of SECTION 03 30 00 - CAST-IN-PLACE CONCRETE.
  - 1. Place concrete in accordance with ACI 301 and 304. Deposit concrete so that specified slab thickness will be obtained with use of a vibratory screed and finishing operations. Minimize handling to prevent segregation. Consolidate concrete by suitable means to prevent formation of voids or honeycombs. Exercise care to prevent disturbance of forms and reinforcing and damage to vapor retarder. Place concrete to lines and levels shown, properly sloped to drain into adjacent yard areas or drainage structures. Concrete shall be placed using a walk behind screed machine (Magic Screed). In addition, a backpack vibrator shall be used. A minimum of two (2) screed machines and backpack vibrators shall be present during all concrete pours. The surface shall be troweled and edged with a steel trowel and then broomed to obtain a smooth, uniform brush finish.
  - 2. Hot Weather Placement: ACI 305.
  - 3. Cold Weather Placement: ACI 306.
  - 4. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
  - 5. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
  - 6. The Contractor shall not back over the steel at anytime while pouring concrete. Construction sequencing efforts shall be utilized in order to successfully make each concrete pour. If necessary, the Contractor shall utilize concrete pumping to perform the work.

- D. Expansion Joints: Locate expansion joints around fixed objects within or abutting concrete, and at intervals of not more than 35 ft. o.c. along walks and curbs and 150 ft. o.c. along drive and parking paving unless otherwise shown on the plans.
1. Install preformed filler with the top edge approximately 1/4" below the finished concrete surface to leave a neat, straight joint.
  2. Joints shall be 1/2" wide unless specifically dimensioned otherwise on the drawings. Joint edges shall be rounded with an edging tool.
  3. There shall be no connection by reinforcement or keyway across expansion joints. Joints shall be held in alignment with sleeved, smooth dowels where required.
  4. The use of redwood expansion joints is prohibited.
- E. Scoring:
1. Saw cut walks, approaches, and paving using an abrasive or diamond blade. Cut joint width shall be 1/8" and depth shall be 1/4" deep at walks and 1/3 slab thickness at approaches and paving. Cutting of joints must be done as soon as concrete surface is firm enough not to be torn or damaged by the blade (within 4 to 12 hours), and before random shrinkage cracks can form in the concrete slab.
    - a. Score walks at approximately 5-foot intervals each way.
    - b. Score curbs and curbs and gutters to match adjacent paving joints.
    - c. Score approaches and paving at 15 foot maximum intervals each way or as shown.
- F. Standard Finishing: Strike slabs off true by double screeding to the required level at or below the elevations and grades shown on the drawings. Set edge forms and screed strips accurately to produce the designated elevations and contours.
1. Walks: Float with wood floats to true planes with no coarse aggregate visible. Hand trowel to produce smooth surfaces. Brush surfaces with a soft fiber brush to produce a uniformly striated finish. Edge concrete surfaces with a rounded edging tool.
  2. Curbs and gutters: All curbs shall hand formed and finished. Cross brush surfaces with a soft fiber brush to produce a fine brush finish.
  3. Approaches: Screed and float to a monolithic medium float finish and belt with a canvas belt to produce a herringbone texture finish.
    - a. Curb Ramps: Provide tooled grooves with chemical staining of concrete as detailed (if required).
- G. Curing:
1. Cure concrete 7 days. Coat exposed surfaces with curing compound, white pigmented for paving and clear for flatwork, and protect surfaces from pedestrian and vehicular traffic during the curing period. Damaged areas shall be re-sprayed. Curing compound shall conform to the specifications of ASTM C309, Type 2.
  2. Removing Forms: Forms shall remain in place for at least 12 hours after concrete has been placed and finished. Remove forms without damaging the concrete. Bars and heavy tools shall not be used to pry against the concrete in removing the forms. Repair all honey combs. Backfill all curbs.
- 3.5 FIELD QUALITY CONTROL
- A. Concrete Tests: Testing and acceptance of concrete shall meet the requirements specified in the plans and specifications and by the geotechnical firm.
- B. Grade and Smoothness Tests:
1. Plan Grade: Finished surface of the flatwork shall not vary more than 0.04 ft. above or below the plan grade or elevation. Finished surfaces of abutting pavement and walks shall coincide at their juncture. Where a new pavement or walk abuts an existing surface, transition pavement or walk strip shall be installed.
  2. Surface Smoothness: Finished surface of the flatwork shall have no abrupt changes of more than 1/8" and shall not deviate from the testing edge of a 12 ft. straight edge more than 1/4" plus or minus tolerance. Flow line of gutters shall not deviate from the testing edge of a 10 ft. straight edge more than 1/8" plus or minus tolerance.
- C. Concrete Cracking:
- Contractor is responsible for controlling all concrete cracking.
1. Pavement: If more than one (1) crack per panel occurs, the Contractor may be required to remove and replace the panel as directed by the Engineer or Owner.
  2. Sidewalk and Flatwork: Where cracking occurs, Contractor to remove and replace entire panel.



3.6 CLEANING

- A. Remove debris, scraps, surplus materials, tools and equipment from the premises upon completion of the work. Clean concrete droppings from walks and curbs. Leave the graded areas free of debris and rubble.

3.7 PROTECTION

- A. Immediately after placement, protect concrete under provisions of SECTION 01 50 00 – CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. The pavement shall be closed to all traffic, including vehicles of the Contractor, until the concrete is at least 7 days old or has attained a minimum average of 3,500 psi compressive strength. Repair any damage to the pavement prior to the acceptance by Owner at no additional cost to the Owner. This does not relieve the Contractor from the normal liabilities, and maintenance responsibilities, implied or otherwise, for the pavement or other items.

**END OF SECTION**

## SECTION 32 17 23

### PAVEMENT MARKINGS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

##### 1.2 SUMMARY

- A. Section Includes: Pavement marking on Portland Cement Concrete Pavement.
- B. Related Sections:
  - 1. Section 32 13 13 - CONCRETE PAVING

##### 1.3 REFERENCES

- A. Federal Specification (FS):
  - 1. FS - TT P 1952F Paint, Traffic, and Airfield Marking, Waterborne.

##### 1.4 PROJECT CONDITIONS

- A. Environmental Requirements Apply paint when ambient temperature is 50°F. or above, and relative humidity is below 85%.

##### 1.5 QUALITY ASSURANCE

- A. Installer: Shall have a minimum of 2 years experience in the layout and striping of parking lots.
- B. Job Conditions: Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40 degrees F., nor when such conditions are anticipated during eight hours after application.

##### 1.6 SUBMITTALS

- A. Submit manufacturer's product data and installation instructions.
- B. Substitutions: Submit in accordance with SECTION 01 60 00 - PRODUCT REQUIREMENTS.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Traffic Paint: Fed. Spec. TT-P-1952F, alkyd-chlorinated rubber-chlorinated paraffin marking paint. Striping colors per plans and City requirements. Provide Premium Chlorinated Rubber Base Paint as manufactured by Sherwin Williams or approved equivalent.
- B. Cleaning Solvent: VM & P Naphtha.

##### 2.2 EQUIPMENT

- A. Applicators: Hand-operated push type marking machine or conventional airless spray equipment with guide lines and templates.

#### PART 3 - EXECUTION

##### 3.1 PREPARATION

- A. Surface Conditions: Clean and dry free from dirt, loose paint, oil, grease, wax, and other contaminants.
  - 1. Asphalt Surfaces: Allow asphaltic concrete to cure a minimum of 48 hours prior to application of marking paint.
- B. Equipment Condition: Clean previously used paint and solvent from application equipment, using VM & P Naphtha.
- C. Paint: Stir contents thoroughly from bottom of container. Do not thin paint.

- D. Locate markings as indicated on Drawings. Provide qualified technician to supervise equipment and application of markings. Lay out markings using guide lines, templates and forms.
  - E. Allow paving to cure before painting as required by manufacturer of traffic paint.
  - F. Allow protective coating to cure a minimum of 48 hours prior to application of traffic paint.
- 3.2 APPLICATION
- A. Using approved equipment, apply paint to a minimum thickness of 15 mils. Stripes shall be 4" wide. Marking edges of stripes and symbols shall be sharply outlined.

**END OF SECTION**

## SECTION 32 19 00

### WALK, ROAD, AND PARKING APPURTENANCES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

##### 1.2 WORK INCLUDED

- B. Provide and install handicapped parking signs and traffic directional signs.

##### 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
  1. ASTM A591 Steel Sheet, Cold-Rolled, Electrolytic Zinc- Coated.
  2. ASTM B209 Aluminum and Aluminum-Alloy Sheet and Plate.
  3. ASTM C33 Concrete Aggregates
  4. ASTM C150 Portland Cement

- B. AASHTO M268

##### 1.4 SUBMITTALS

- A. Product Data: Submit in accordance with SECTION 01 33 23 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include catalog, cuts of each type of sign and manufacturer's installation instructions.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle signs in accordance with SECTION 01 60 00 – PRODUCT REQUIREMENTS and in manufacturer's cartons. Store off ground on planking. Cover with non-staining plastic.

##### 1.6 PROJECT CONDITIONS

- A. Coordinate installation of signs with work of other trades.
- B. Location of signs shall be in accordance with City and State requirements. Signs shall be positioned not to conflict with automobile or pedestrian traffic.

#### PART 2 - PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURER

- A. Site signs: As manufactured by Sa So (Sargent Sowell, Inc.) 525 N. Great SW Pkwy, Arlington, Texas, 76011 (phone 972-647 4911), or approved equivalent.

##### 2.2 MATERIALS

- A. Sign Materials: Aluminum Sheets: ASTM B 209, alloy 6061 T6, degreased and etched, 0.080" thickness. Sign faces shall be fully reflectorized with material conforming to AASHTO M268.
- B. Bolts, Nuts, Washers, and Clamps: Cadmium or galvanized steel. Bolts shall be a minimum of 5/16" in diameter. Clamps shall be two-piece assemblies of at least 14-gage steel or shall be an adjustable steel strap bracket.
- C. Posts: Standard galvanized steel pipe 2-3/8" in diameter and weighing not less than 2 lbs. per linear foot.
- D. Concrete: Provide concrete consisting of Portland cement (ASTM C150), aggregates (ASTM C33), and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi, using at least 4 sacks of cement per cubic yard, 1 inch maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

##### 2.3 SITE SIGNS

- A. General: Site signs shall be of the quality manufactured by Sa-So and are listed by Sa-So catalog numbers for convenience in identification.

- B. Accessible Parking Signs: Reflective .080 Aluminum.
- C. Accessible Loading Zone Sign: Reflective .080 Aluminum.
- D. Traffic Signs: Reflective sheeting per details.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Excavation: Drill holes of the size indicated for posts. Excavate holes to the depths indicated. Remove excess concrete and excavated soil from the site.
- B. Setting Posts:
  - 1. Remove all loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete. Center and align posts in holes.
  - 2. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Trowel finish tops of footings, and slope or dome to direct water away from posts.
- C. Attach signs to posts with bolts, washers, nuts and clamps.
- D. Clean exposed sign faces and galvanized surfaces, and leave free of defects. Use no abrasives. Leave pavement and graded area clean and free of debris.

**END OF SECTION**

SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

The requirements of the "General Conditions of the Contract" and of Division 1, "General Requirements", shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

- A. Provide all labor, materials, transportation, and services necessary to furnish and install Irrigation Systems as shown on the drawings and described herein.
- B. Related work in other sections:
  - 1. 32 92 23 SOD
  - 2. 32 93 00 TREES, SHRUBS, AND GROUNDCOVERS
- C. The term of "LICENSED IRRIGATOR" shall refer to Teague Nall and Perkins, Inc., 5237 N. Riverside Drive, Suite 100, Fort Worth, Texas 76137.

1.3 QUALITY ASSURANCE & REQUIREMENTS

- A. Permits and Fees: The Contractor shall obtain and pay for any and all permits and all observations as required.
- B. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturers of articles used in this contract furnish directions covering points not shown in the drawings and specifications
- C. Ordinances and Regulations: All local, municipal, and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and make a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations or requirements of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.
- D. Explanation of Drawings:
  - 1. Due to the scale of drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
  - 2. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.
  - 3. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Licensed Irrigator immediately. In the event this notification is not performed, the Irrigation Contractor shall assume full responsibility for any revision necessary.

1.4 SUBMITTALS

- A. Material List:
  - 1. The Contractor shall furnish the articles, equipment, or processes specified by name in the drawings and specifications. No substitution will be allowed without prior written approval by the Licensed Irrigator.

2. Complete material list shall be submitted prior to performing any work. Material list shall include the manufacturer, model number, and description of all materials and equipment to be used.
  3. Equipment or materials installed or furnished without prior approval of the Licensed Irrigator may be subject to rejection, and the Contractor required to remove such materials from the site at his own expense.
  4. Approval of any item, alternate, or substitute indicates only that the product or products apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted.
  5. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.
- B. Record and As-Built Drawings:
1. The Contractor shall provide and keep an up-to-date and complete "as-built" record set of blue line ozalid prints which shall be corrected daily and show every change from the original drawings and specifications, the exact "as-built" locations, sizes, and kinds of equipment. Prints for these purposes may be obtained from the Licensed Irrigator at cost. This set of drawings shall be kept on the site and shall be used only as a record set.
  2. These drawings shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. These drawings shall be available at all times for inspection and shall be kept in a location designated by the Licensed Irrigator. Should the record blue line as-built progress sheets not be available for review or not up-to-date at the time of any inspection (refer to Section 3.09 - Observation Schedule), it will be assumed no work has been completed and the Contractor will be assessed the cost of that site visit at the current billing rate of the Licensed Irrigator. No other observations shall take place prior to payment of that assessment.
  3. The Contractor shall make neat and legible notations on the as-built progress sheets daily as the work proceeds, showing the work as actually installed. For example, should a piece of equipment be installed in a location that does not match the plan, the Contractor must indicate that equipment has been relocated in a graphic manner so as to match the original symbols as indicated in the irrigation legend. The relocated equipment and dimensions will then be transferred to the original as-built plan at the proper time.
  4. Hand drawn: In lieu of electronically drawn, before the date of the final inspection, the Contractor shall transfer all information from the "as-built" prints to a sepia Mylar, or similar Mylar material, procured from the Licensed Irrigator. All work shall be in waterproof India ink and applied to the Mylar be a technical pen made expressly for use on Mylar material. Such pen shall be similar to those manufactured by Rapidograph, Kueffell & Esser, or Faber Castell. The dimensions shall be made so as to be easily readable, even on the final controller chart (see Section C). The original Mylar "as-built" plan shall be submitted to the Licensed Irrigator for approval prior to the making of the controller chart.
  5. Electronically drawn: In lieu of hand drawn, before the date of the final inspection, the Contractor shall transfer all information from the "as-built" prints to an AutoCAD electronic file procured from the Licensed Irrigator. All work shall be documented on a unique and separate layer. The electronically drawn "as-built" plan shall be submitted to the Licensed Irrigator for approval prior to the making of the controller chart.
  6. The Contractor shall dimension from two (2) permanent points of reference - building corners, sidewalks, road intersections, etc. - the location of the following items:
    - a. Connection to existing water lines
    - b. Connection to existing electrical power
    - c. Gate valves
    - d. Routing of irrigation pressure lines (dimension maximum 100' along routing).
    - e. Irrigation control valves.
    - f. Routing of control wiring.
    - g. Quick coupling valves.
    - h. Road and sidewalk borings. With a small masonry blade label each sleeve location with an "S" cut directly above all sleeve ends.
    - i. Other related equipment as directed by the Licensed Irrigator

7. On or before the date of the final inspection, the Contractor shall deliver the corrected and completed sepias to the Licensed Irrigator. Delivery of the sepias will not relieve the Contractor of the responsibility of furnishing required information that maybe omitted from the prints.
- C. Controller Charts:
1. As-built drawings shall be approved by the Licensed Irrigator before controller charts are prepared.
  2. Provide on (1) controller chart for each controller supplied.
  3. The chart shall show the area controlled by the automatic controller and any area under a manual irrigation. The chart shall be the maximum size which the controller door will allow.
  4. The chart is to be a reduced drawing of the actual as-built system. However, in the event the controller sequence is not legible when the drawing(s) is reduced, it shall be enlarged to a size that will be readable when reduced.
  5. The chart shall be a black line or blue line ozalid print. A different color shall be used to indicate the area of coverage for each station.
  6. When completed and approved, the chart will be hermetically sealed between two (2) pieces of plastic, each piece being a minimum 10 mils thickness.
  7. These charts shall be completed and approved prior to final inspection of the irrigation system.
- D. Operation and Maintenance Manuals:
1. Prepare and deliver to the Licensed Irrigator within ten (10) calendar days prior to completion of construction, two (2) hard cover binders with three (3) rings containing the followings information:
    - a. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturer's representative
    - b. Catalog and parts sheets on every material and equipment installed under this contract.
    - c. Guarantee statement.
    - d. Complete operating and maintenance instructions on all major equipment, i.e. the automatic controller(s).
  2. In addition to the above mentioned maintenance manuals, provide the Licensed Irrigator with instructions for major equipment and show evidence, in writing, to the Licensed Irrigator at the conclusion of the project that this service has been rendered.
- E. Equipment to be Furnished:
1. Supply as a part of this Contract the following tools:
    - a. Two (2) sets of special tools required for removing, disassembling and adjusting each type of irrigation head and valve supplied on this project.
    - b. Two (2) five foot valve keys for operation of the ball and remote control valves.
    - c. Two (2) keys for each automatic controller.
    - d. One (1) quick coupler key and matching hose swivel ell for every five (5), or fraction thereof, of each type of quick coupling valve installed.
- 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Handling of PVC Pipe and Fittings: The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been damaged will be discarded and, if installed, shall be replaced with new piping.
- 1.6 SUBSTITUTIONS
- A. If the Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the drawings and specifications, he may do so by providing the following information to the Licensed Irrigator for approval:
1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
  2. Provide descriptive catalog literature, performance charts, and flow charts for each item to be substituted.
  3. Provide the amount of cost savings if the substituted item is approved.



- B. The Licensed Irrigator shall have the sole responsibility in accepting or rejecting any substituted item as an approved equal to those equipment and materials listed on the irrigation drawings and specifications

1.7 GUARANTEE

- A. The guarantee for the planting irrigation system shall be made in accordance with the attached form. The general conditions and supplementary conditions of these specifications shall be filed with the Owner and the Licensed Irrigator prior to acceptance of the irrigation system.
- B. A copy of the guarantee form shall be included in the operations and maintenance manual.
- C. The guarantee form shall be re-typed onto the Contractor's letterhead and contain the following information:

ONE-YEAR WARRANTY & GUARANTEE FOR PLANTING IRRIGATION SYSTEM

We hereby guarantee that the planting irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defects in material or workmanship which may develop to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner for a period of one year after final acceptance of the project. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacement within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT: \_\_\_\_\_

LOCATION: \_\_\_\_\_  
\_\_\_\_\_

SIGNED: \_\_\_\_\_

COMPANY: \_\_\_\_\_

ADDRESS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PHONE: ( \_\_\_\_\_ ) \_\_\_\_\_ - \_\_\_\_\_

DATE OF ACCEPTANCE: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Use only new materials of brands and types noted on drawings, specified herein, or approved equals.
- B. PVC pressure main line pipe and fittings:
  - 1. Pressure main line piping for sizes 3" and larger shall be PVC Class 200 with o-ring gasket joints. All tees, ells and other fitting shall be solvent welded.
  - 2. Pressure main line piping for sizes 2 1/2" and smaller shall be PVC Class 200 with solvent welded joints.
  - 3. Pipe shall be made from NSF approved Type I, Grade II PVC compound conforming to ASTM resin specification D1784. All pipes must meet requirements as set forth in Federal Specification PS-22-70.
  - 4. PVC solvent-weld fittings shall be Schedule 40, 1-2, II-I NSF approved conforming to ASTM test procedure D2466. All male adapters shall be SCH 80 PVC.
  - 5. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.
  - 6. All PVC pipe must bear the following markings:
    - a. Manufacturer's name
    - b. Nominal pipe size
    - c. Schedule or class
    - d. Pressure rating in P.S.I.
    - e. NSF (National Sanitation Foundation) approval
    - f. Date of extrusion
  - 7. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
- C. PVC Non-Pressure Lateral Line Piping:
  - 1. Non-pressure buried lateral line piping shall be PVC class 200 with solvent-weld joints.
  - 2. Pipe shall be made from NSF approved, Type I, Grade II PVC compound to ASTM resin specification D1784. All pipes must meet requirements set forth in Federal Specification PS-22-70 with an appropriate standard dimension ratio.
  - 3. Except as noted in paragraphs 1 and 2 of Section 2.01B, all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as set forth in Section 2.01B of these specifications.
- D. Copper Piping and Fittings:
  - 1. Copper piping shall be type "K" hard-drawn with "sweat" type fittings.
  - 2. Pipe and fittings shall be assembled with 50/50 soft solder and non-erosive flux. Solder shall take up capillary action and joints shall be made tight without build-up head.
  - 3. Pipe ends shall be squared, reamed to remove burrs, and cleaned bright with fine sandpaper and steel wool.

- E. Ball Valves:
  - 1. Ball valves 3" and smaller shall be similar to those manufactured by Lasco, or approved equal.
  - 2. Ball valves 3" and smaller shall have threaded ends shall be equipped with a hand lever.
  - 3. All ball valves shall be installed per installation detail and the manufacturer's recommendations.
- F. Quick Coupling Valves: Quick coupling valves shall have a brass two-piece body designed for working pressure of 150 p.s.i. operable with quick coupler. Key size and type shall be as shown on the plans.
- G. Backflow Prevention Units:
  - 1. Backflow prevention units shall be of size and type indicated on the drawings. Install backflow prevention units in accordance with irrigation construction details.
  - 2. Wye strainers at backflow prevention units shall have a bronzed, screwed body with 60 mesh monel screen and shall be similar to Bailey #100B, or approved equal. Mount wye strainers sideways so they are easier to service.
- H. Automatic Drain Valves:
  - 1. Automatic drain valves shall be plunger type, duty virgin PVC construction, with small thread inlet.
  - 2. Drain valve shall be installed at an angle of 30 to 45 degrees horizontal, in a direction to facilitate pipe drainage.
  - 3. Provide sump pit for drainage.
- I. Control Wiring:
  - 1. Connections between the automatic controllers and the electric control valves shall be made with direct burial copper wire, AWG-U.F. 600 volt.
  - 2. Pilot wires shall be a different color wire for each automatic controller.
  - 3. Common wires shall be white with a different color stripe for each automatic controller.
  - 4. Install in accordance with valve manufacturer's specifications and wire chart. In no case shall the wire size be less than #12 gauge.
  - 5. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.
  - 6. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of ten (10) feet.
  - 7. An expansion curl shall be provided within three (3) feet of each wire connection. Expansion curl shall be of sufficient length at each splice connection at each electric remote control valve, so that in case of repair, the valve bonnet may be brought to the surface without disconnecting the control wires. Control wires shall be laid loosely in the trench without stress or stretching of control wire conductors.
  - 8. All splices shall be made with Scotch-Lok #3576 Connector Sealing Packs, Rain Bird Snap-Tite wire connector, or approved equal. Use one (1) splice per connector sealing pack.
  - 9. Field splices between the automatic controller and electrical control valves will not be allowed without prior approval of the Licensed Irrigator. All approved field splices shall be placed in a Control Valve Box and labeled appropriately.
- J. Automatic Controllers:
  - 1. Automatic controllers shall be of size and type shown on the plans.
  - 2. Final location of the automatic controller shall be approved by the Licensed Irrigator.
  - 3. Unless otherwise noted on the plans, the 120 volt electrical power to each automatic controller location shall be furnished by the Contractor. The final electrical hook-up shall be the responsibility of the Contractor.
- K. Electrical Control Valves:
  - 1. All electric control valves do not have to be the same manufacture as the automatic controller.
  - 2. All electric control valves shall have a manual flow adjustment.
  - 3. Furnish and install one (1) control valve box for each electric control valve.
- L. Control Valve Boxes:
  - 1. Use 10" round box for all field splices, Oldcastle Enclosure Solutions Model 910 with green cover, or approved equal. Extension sleeves shall be 6" PVC minimum size.
  - 2. Use 14" X 19" standard rectangular box for all gate valves and quick coupler valves, Oldcastle Enclosure Solutions Model 1419 with green, "Drop-N-Lock" lid cover, or approved equal. Extension sleeves shall be 6" PVC minimum size.

3. Use 13" X 24" jumbo rectangular box for all electric control valves, Oldcastle Enclosure Solutions Model 1324 with green, "Drop-N-Lock" lid cover, or approved equal. Extension sleeves shall be 6" PVC minimum size.

M. Irrigation Heads:

1. All irrigation heads shall be of the same size, type, and deliver the same rate of precipitation with the diameter (or radius) of throw, pressure, and discharge as shown on the drawings, or specified in these special provisions.
2. Spray heads shall have a screw adjustment.
3. Riser units shall be fabricated in accordance with the details shown on the plans.
4. Riser nipples for all irrigation heads shall be the same size as the riser opening in the irrigation body.
5. All irrigation heads of the same type shall be of the same manufacture.

### PART 3 - EXECUTION

#### 3.1 INSPECTION

A. Site Conditions:

1. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive the Licensed Irrigator's approval prior to proceeding with work under this section.
2. Exercise extreme care in excavating and working near existing utilities. The Contractor shall be responsible for damages to utilities which are caused by his operations or neglect. Check existing utilities drawings for existing utility locations.
3. Coordinate installation of planting irrigation materials including pipe, so there shall be NO interference with utilities or other construction or difficulty in planting trees, shrubs, and ground covers.
4. The Contractor shall carefully check all grades to satisfy himself that he may safely proceed before starting work on the planting irrigation system.

#### 3.2 PREPARATION

A. Physical Layout:

1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of irrigation heads.
2. All layout shall be approved by the Licensed Irrigator prior to installation.

B. Water Supply:

1. Planting irrigation system shall be connected to water supply points of connection as indicated on the drawings.
2. Connections shall be made at approximate locations as shown on the drawings. The Contractor is responsible for minor changes caused by actual site conditions.
3. The point of connection shall be as shown on the drawings and shall be furnished by the Contractor, unless otherwise specified.

C. Electrical Supply:

1. Electrical connections for the automatic controller shall be made to electrical points of connection as indicated on the drawings.
2. Connections shall be made at approximate locations, as shown on the drawings. The Contractor is responsible for minor changes caused by actual site conditions.

#### 3.3 INSTALLATION

A. Trenching:

1. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on the drawings, and as noted.
2. Provide for a minimum of eighteen (18) inches cover for all pressure supply lines.
3. Provide for a minimum cover of twelve (12) inches for all non-pressure lines.
4. Provide for a minimum cover of eighteen (18) inches for all control wiring.

B. Backfilling:

1. The trenches shall be backfilled a maximum of 50% with all joints exposed until all required tests are performed. Trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials, free from large clods of earth or stones. Backfill shall be mechanically compacted landscaped areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill will conform to adjacent grades without dips, sunken areas, humps, or other surface irregularities.
  2. A fine granular material backfill will be initially placed on all lines. No foreign matter larger than one-half (1/2) inch in size will be permitted in the initial backfill.
  3. Flooding of trenches will always be permitted and preferred.
  4. If settlement occurs and subsequent adjustments in pipe, valves, irrigation heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the Owner.
- C. Trenching and Backfill Under Paving:
1. Trenches located under areas where paving, asphaltic concrete or concrete, will be installed shall be backfilled with sand (a layer of six [6] inches below the pipe and three [3] inches above the pipe) and compacted in layers to 95% standard proctor, using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and shall be left in a firm, unyielding condition. All trenches shall be left flush with the adjoining grade. The Contractor shall set in place, cap, and pressure test all piping under paving prior to the paving work.
  2. Generally piping under existing walks is done by jacking, boring, or hydraulic driving, but where any cutting or breaking of sidewalks or concrete is necessary, it shall be done and replaced by the Contractor as part of the contract cost, to the satisfaction of the Licensed Irrigator. Permission to cut or break sidewalks or concrete shall be obtained from the Licensed Irrigator. NO hydraulic driving will be permitted under concrete paving.
  3. Provide for a minimum cover of eighteen (18) inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete paving.
- D. Assemblies:
1. Routing of planting irrigation lines as indicated on the drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform to the details per plans.
  2. Install NO multiple assemblies in plastic lines. Provide each assembly with its own outlet.
  3. Install all assemblies specified herein in accordance with the respective detail. In the absence of detail drawings or specifications pertaining to specific items required to complete the work, perform such work in accordance with the best standard practice, with the approval of the Licensed Irrigator.
  4. PVC pipe and fittings shall be thoroughly cleaned of dirt, dust, and moisture before the installation. Installation and solvent welding methods shall be as recommended by the pipe and fitting manufacturer.
  5. On PVC to metal connections, the Contractor shall work the metal connections first. Teflon tape, or approved equal, shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded.
- E. Line Clearance: All lines shall have a minimum clearance of six (6) inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.
- F. Automatic Controller: Install the automatic controller(s) in accordance with the manufacturer's instructions. Remote control valves shall be connected to the controller in the numerical sequence as shown on the drawings.
- G. High Voltage Wiring for Automatic Controller:
1. 120 volt electrical service for the automatic controller shall be the responsibility of the Contractor. The Contractor shall be responsible for permitting and getting the electrical utility service company to install the appropriate electrical service and meter base necessary to operate each automatic controller. The final location of the electrical meter base shall be approved by the Licensed Irrigator.
  2. 120 volt electrical service connection to the automatic controller shall be provided by the Contractor.

3. All electrical work shall conform to local codes, ordinances, and union authorities having jurisdiction.
- H. Remote Control Valves: Install remote control valves where shown on the drawings and per the detail. When valves are grouped together, allow at least thirty-six (36) inches between valves. Install each remote control valve in a separate valve box. Each valve number (per the drawings) shall be stenciled on the valve box lid with exterior paint. Paint color shall be flat black. Stencil number size shall be 3" in height. Additionally, on each valve install a waterproof tag with the valve number legibly written. Afix to the valve using plastic tie or galvanized wire that will not impede the manual operation of the valve.
- I. Ball Valves: Install ball valves where shown on the drawings and per the detail. When valves are grouped together, allow at least thirty-six (36) inches between valves. Install each ball valve in a separate valve box. Each ball valve shall have stenciled on the valve box lid, "BV" with exterior paint. Paint color shall be flat black. Stencil letter size shall be 3" in height.
- J. Quick Coupler Valves: Install where shown on the drawings and per the detail. Install each quick coupler valve in a separate valve box. Each quick coupler valve shall have stenciled on the valve box lid, "QC" with exterior paint. Paint color shall be flat black. Stencil letter size shall be 3" in height.
- K. Flushing of the System:
  1. After all new irrigation pipe lines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of the irrigation heads, the control valves shall be opened and full head of water used to flush out the system.
  2. Irrigation heads shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the Licensed Irrigator.
- L. Irrigation Heads:
  1. Install the irrigation heads as designated on the drawings. Irrigation heads to be installed in this work shall be equivalent in all respects to those itemized.
  2. Spacing of heads shall not exceed the maximum indicated on the drawings. In NO case shall the spacing exceed the maximum recommended by the manufacturer.
- M. Field Splices: Install field splices of control valve wiring in a valve box (see Section 2.01 L.1). Each field splice valve box lid shall have stenciled "Field Splice" on it with exterior paint. Paint color shall be flat black. Stencil letter shall be 3" in height.

### 3.4 TEMPORARY REPAIRS

The Owner reserves the right to make temporary repairs as necessary to keep the irrigation system equipment in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibilities under the terms of the guarantee as herein specified.

### 3.5 FIELD QUALITY CONTROL

- A. Adjustment of the System:
  1. The Contractor shall flush and adjust all irrigation heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible.
  2. If it is determined by the Licensed Irrigator that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to planting. Adjustments may also include changes in nozzle sizes and degrees of arc as required.
  3. Lowering raised irrigation heads by the Contractor shall be accomplished within ten (10) calendar days after notification by the Licensed Irrigator.
  4. All irrigation heads shall be set perpendicular to finished grades unless otherwise designated on the drawings.
- B. Testing of Irrigation System:
  1. The Contractor shall request the presence of the Licensed Irrigator, in writing, at least 24 hours in advance of the testing.
  2. Test all pressure lines under hydrostatic pressure of 150 pounds per square inch, and prove watertight. Note that the testing of pressure main lines shall occur prior to installation of the electric remote control valves.

3. All piping under paved areas shall be tested under hydrostatic pressured of 150 pounds per square inch, and proved watertight, prior to paving.
4. Sustain pressure in lines for not less than eight (8) hours. If leaks develop, replace joints and repeat the test until the entire system is proven watertight.
5. All hydrostatic tests shall be made only in the presence of the Licensed Irrigator. NO pipe shall be completely backfilled until it has been inspected, tested, and approved in writing.
6. Furnish necessary force pump and all other test equipment.
7. When the planting irrigation system is completed, perform a coverage test in the presence of the Licensed Irrigator, to determine if the water coverage for planting areas is complete and adequate. Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from plans, or where the system has been willfully installed, as indicated on the drawings, when it is obviously inadequate, without bringing this to the attention of the Licensed Irrigator. This test shall be accomplished before any ground cover is planted.
8. Upon completion of each phase of work, the entire system shall be tested and adjusted to meet site requirements.

### 3.6 MAINTENANCE

- A. The entire planting irrigation system shall be under full automatic operation for a period of seven (7) calendar days prior to any planting.
- B. The Licensed Irrigator reserves the right to waive or shorten the operation period.

### 3.7 CLEAN-UP

Clean-up shall be made daily as each portion of the work progresses. Refuse and excess dirt shall be removed, all walks and paving shall be broomed or washed down, and any damage sustained on the work of others shall be repaired to the original condition.

### 3.8 FINAL OBSERVATION PRIOR TO ACCEPTANCE

- A. The Contractor shall operate each system in its entirety for the Licensed Irrigator, at the time of the final observation. Any items deemed not acceptable by the Licensed Irrigator shall be re-worked to the complete satisfaction of the Licensed Irrigator.
- B. The Contractor shall show evidence to the Licensed Irrigator that the Owner has received all accessories, charts, record drawings, and equipment as required before final inspection can occur.

### 3.9 OBSERVATION SCHEDULE

- A. The Contractor shall be responsible for notifying the Licensed Irrigator, in advance, for the following observation meetings, according to the time indicated:
  1. Pre-Job Conference - 7 days.
  2. Pressure supply line installation & testing - 48 hours
  3. Automatic controller installation - 48 hours
  4. Control wire installation - 48 hours
  5. Lateral line and irrigation installation - 48 hours
  6. Coverage test - 48 hours
  7. Final inspection - 7 days
- B. When observations have been conducted by other than the Licensed Irrigator, show evidence, in writing, of when and by whom these observations were made.
- C. NO site observations will commence without as-built drawings. In the event the Contractor calls for a site visit without as-built drawings, without completing previously noted corrections, or without preparing the system for the said visit, he shall be responsible for reimbursing the Licensed Irrigator at his current billing rates per hour, portal to portal (plus transportation costs) for the inconvenience. NO further site visits will be scheduled until this charge has been paid and received.

END OF SECTION

PLANTING IRRIGATION  
32 84 00 - 11



SECTION 32 92 13

HYDROMULCHING

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

The requirements of the "General Conditions of the Contract" shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

- A. Furnish all labor, material, equipment, and services necessary to provide all landscape hydro-seeding work, complete in place, as shown on the drawings and as specified.
- B. Work specified in this Section: The work includes, but is not necessarily limited to:
  - 1. Soil preparation
  - 2. Fine grading
  - 3. Seeding via Hydrosprayer (A slurry of seed, fertilizer, water, tackifiers, biologically active soil conditioners, a color dye, and organic mulch fibers)
  - 4. Clean-up
  - 5. Maintenance
- C. Related work in other Sections:
  - 1. 32 84 00 PLANTING IRRIGATION
  - 2. 32 92 23 SOD
  - 3. 32 93 00 TREES, SHRUBS, AND GROUNDCOVERS
- D. Definition: The term of "Landscape Architect" shall refer to Teague Nall and Perkins, Inc., 5237 N. Riverside Drive, Suite 100, Fort Worth, Texas 76137.
- E. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
  - 1. American Society for Testing and Materials (ASTM): D 1557 Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb. (4.54 kg) Rammer and 18 in. (457mm) Drop.

1.3 SUBMITTALS

- A. Samples and Product Information: Representative samples or product information of the following materials shall be provided to the Landscape Architect from the supply source that is to be used for turf seeded areas and native wildflower or native grass seeded areas:
  - 1. Topsoil
  - 2. Soil Amendments
  - 3. Fertilizer: specifications and guaranteed analysis.
  - 4. Biological Amendments: ingredients, chemical analysis, and manufacturer.
  - 5. Seed type and purity analysis. Save labels for field inspection by LA.
  - 6. Tackifier material components and manufacturer.
  - 7. Hydromulch manufacture and type of mulch to be used.
- B. Construction Schedule: At least two weeks prior to start of work, submit seeding schedule.
- C. Maintenance: Submit three copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of the lawns for an entire year. Submit prior to Notice of Substantial Completion. See Section 3.10, 90 DAY MAINTENANCE
- D. Chemicals: Submit products, rates of application, and anticipated uses of any pesticides, herbicides, and fumigants.

1.4 QUALITY ASSURANCE

- A. Contractor's Qualifications
  - 1. The work of this section shall be performed by a Contractor specializing in hydro-seeding.
  - 2. The Contractor shall have successfully completed at least 5 installations of this type, size, and complexity in the last four years.
- B. Materials shall comply with all government regulations prevailing at the supply source and the job site.

- C. Fertilizers; Mixed Commercial. Federal Specification: 0-F-241D

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handling and Storage of Seed: Seed shall be kept dark, cool (between 40-50 degrees F), and dry until time of planting.

#### 1.6 JOB CONDITIONS

- A. Do not install seed on saturated, excessively dry, or frozen soil.
- B. Seed installation shall be subject to suitability of the weather and other conditions affecting seed germination.
- C. Planting season may be extended only with the written permission of the Landscape Architect.

#### 1.7 SAMPLES AND TESTS

- A. The Landscape Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. The Contractor shall furnish samples upon request by the Landscape Architect. Rejected materials shall be immediately removed from the site at the Contractor's expense. Cost of the testing of materials not meeting specifications shall be paid by the Contractor.
- B. After rough grading is complete, Contractor shall order and pay for a soil test which includes recommendations. Take a minimum of one soil test per 10 acres - or more as site conditions mandate. Take approximately 15 cores from each uniform soil area. Mix them thoroughly in a clean plastic or paper container. Fill the soil sample bag one-third to one-half full from this representative sample. Acceptable labs are:
  - 1. TPS Lab: "SO-05, TPSL® Plant Natural™ Soil Test + LOI Organic Matter + Solvita®"
  - 2. A&L Plains Agricultural Laboratories: "Basic Test S2" and "Basic Test S3" and "Organic Matter – by Combustion" (all three tests are required)
- C. Submit results to Landscape Architect for adjustment to soil amendments and fertilizers.

#### 1.8 MAINTENANCE

- A. All stored plant material shall be maintained in a healthy, vigorous condition by the Contractor. Maintenance includes, but is not necessarily limited to, mowing, weeding, edging, watering, trash removal, street and gutter cleaning, erosion repair, removal of siltation in drainage areas, and insect and disease chemical applications. The storage area shall be mowed, weeded, and trimmed weekly during the course of construction and the life of the storage area.
- B. Within the limits of construction, the site shall be maintained in a neat, well-kept appearance by the Contractor. Maintenance includes, but is not necessarily limited to, mowing, weeding, edging, watering, trash removal, street and gutter cleaning, erosion repair, removal of siltation in drainage areas, and insect and disease chemical applications.
- C. Contractor shall maintain plant material as described in Part 3.10, 90-DAY MAINTENANCE

#### 1.9 GUARANTEE AND REPLACEMENT

- A. Warrant all hydromulched areas for a period of one year from date of Notice of Substantial Completion, to be at least the quality and conditions as at Final Acceptance. Promptly reseed bare or unacceptable areas during the warranty period as directed by the Landscape Architect.
- B. Lawns shall be uniform in color, grass type, leaf texture, leaf and root density, and free from weeds, diseases, and other visible imperfections at acceptance.
- C. Damage to the irrigation system by other trades or persons (such as shutting off of water or power to the irrigation system) shall not affect the warranty. This means that, especially in the warm season, the Contractor shall make daily visits to the site to inspect and repair the irrigation system up until final acceptance.

#### 1.10 FINAL INSPECTION AND ACCEPTANCE

- A. The Landscape Architect will inspect all work for Substantial Completion upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.

- B. Acceptance will be based on establishment of a uniform stand of turf grass, defined as coverage of specified grass at a density of 95 percent coverage, with no bare spots greater than one square foot, free of weeds, undesirable grass species, disease, and insects. For grass varieties selected, allow a minimum of 90 days for establishment and maintenance of an acceptable strand of grass.
- C. In areas that are grassed and not irrigated. An acceptable strand of grass shall be established and the Landscape Architect will inspect the work for Substantial Completion upon written request of the Contractor.
- D. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Landscape Architect, the Landscape Architect will recommend to the Owner that the work of this Section be accepted.

## PART 2 - MATERIALS

### 2.1 HYDROMULCHING

- A. All seed shall be fresh, clean, dry new crop seed tested for minimum percentages of purity and germination and label in accordance with the U.S. Department of Agriculture regulations. Seed tags shall not be more than 9 months old.
  - 1. Pure Live Seed (PLS) shall not be less than 90 percent.
  - 2. Maximum weed content shall be 0.30 percent.
- B. Bermuda seed type shall be hulled certified 'Sahara II' Bermuda by Pennington Seed. Seed shall contain certified seed composed of the following PLS (by weight):
  - 1. Material: Permanent seed variety.
  - 2. Seed: Must be Certified Sahara II.
  - 3. Inert Material: Less than 1%.
  - 4. Other Crop Seed: Less than .5%.
  - 5. Weed Seed: Less than 1%.
  - 6. Coating: MYCO Advantage coated.
  - 7. Packaging: 25lb Plastic container
- C. Southeast Recovery Mix shall be a specified mixture of grass and wildflower seeds from Native American Seed (800) 728-4043.
- D. Root Inoculant: SaberEx for Wheat and Cereals by ABM (or approved equal). Apply as a dry seed treatment prior to seeding:
  - 1. Active Ingredient: 1.0% Trichoderma harzianum 2.5x10<sup>7</sup> cfu/gm
  - 2. Inert Ingredients: Graphite 60.0%, Cellulose 24.0%, Talc 15.0%
- E. Tackifier: By Profile Products or approved equal. Tackifier shall be included in Hydromulch and factory mixed. Follow manufacturer's recommendations.
- F. pH Soil Doctor: (granular humate soil amendment) from Browning Seed, Inc. (800) 243-5271, <http://www.browningseed.com> or approved equal, with formulation of:
  - 1. Humic Acid 37.50%
  - 2. Calcium (CaSo<sub>4</sub>) 10.00%
  - 3. Sulfur (S) 7.00% (to lower pH)
  - 4. Calcium Sulfate(CaSo<sub>4</sub>) 34.00% (Derived from quarried calcium sulfate)
  - 5. Water Soluble Binder-lignosulfonate .50%
- G. Fertilizer for Hydromulch areas: Italtollina 4-4-4 or approved equal. Product shall be an OMRI registered organic fertilizer of a guaranteed analysis, 4-4-4, containing no less than 41% total organic Carbon, 71% organic matter, and 5% humic acid. Contact: Allen Olson (817) 368-8615, [allen@gdrsistemas.net](mailto:allen@gdrsistemas.net)
- H. Hydromulch: Shall be manufactured by Profile Products LLC or approved equal. Hydromulch shall be a fully biodegradable, Hydraulic Mulch composed of 100% recycled Thermally Refined wood fibers, cellulose fibers, and wetting agents (including high-viscosity colloidal polysaccharides). Hydromulch shall be phytosanitized, free from plastic netting, and upon application form an intimate bond with the soil surface to create a porous, absorbent and flexible erosion resistant blanket that allows for rapid germination and accelerated plant growth.
  - 1. Seeded areas less than 5:1 slope: Soil Cover Blend with Tack, by Profile Products:
    - a. Thermally Refined® Wood Fibers (minimum) – 58%
    - b. Cellulose Fiber (maximum) – 27%
    - c. Polymer Tackifier – 3% ± 0.5%
    - d. Moisture Content – 12% ± 3%

2. Seeded areas with slopes 5:1 or greater: Flexterra HP-FGM, by Profile Products:
  - a. All components of the HP-FGM shall be pre-packaged by the Manufacturer to assure both material performance and compliance with the following values. Under no circumstances shall field mixing of components be permitted. No chemical additives except for fertilizer, soil neutralizers and biostimulant materials should be added to this product.
  - b. Thermally Processed\* (within a pressurized vessel) Virgin Wood Fibers – 80%
  - c. \*Heated to a temperature greater than 380 degrees Fahrenheit (193 degrees Celsius) for 5 minutes at a pressure greater than 50 psi (345 kPa)
  - d. Wetting agents (including high-viscosity colloidal polysaccharides, cross-linked biopolymers, and water absorbents) – 10%
  - e. Crimped Biodegradable Interlocking Fibers – 5%
  - f. Micro-Pore Granules – 5%

## 2.2 TOPSOIL

- A. All existing topsoil stripped for this work and suitable for reuse shall be stored on site as directed by the Landscape Architect. Dispose of all excess topsoil on the site as directed by the Landscape Architect.
- B. Utilize on-site and imported topsoil to provide a minimum six inch (6") layer of approved soil for hydromulch installation as specified and indicated on the Drawings.
- C. If on-site topsoil is not available, imported topsoil shall be used as indicated on the drawings and as follows:
  1. Imported Top Soil shall be natural, loose, fertile, friable, screened agricultural soil, having characteristics of representative productive soils in the vicinity, and obtained from naturally well-drained areas. Imported Soil for seeded areas to be: "Enriched Top Soil", by Soil Building Systems, (972) 831-8181, or approved equal, submit a 1-quart package with supplier label attached to sample
  2. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing the 2.0 millimeter sieve. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECe) of the saturation extract of this soil shall not exceed 3.0 millimhos per centimeter at 25 degrees centigrade. The boron content shall be no greater than 1 part per million as measured on the saturation extract. In order to insure conformance, samples of the import soil shall be submitted to the laboratory for analysis prior to, and following, backfilling.
  3. Imported Top Soil shall be free of insects, harmful nematodes, soil-borne diseases, toxins, heavy clay, select fill, inorganic subsoils, heavy metals, trash, petroleum by-products, rocks over 1" diameter, rubble, roots, weeds, or weed seeds.
  4. Imported Topsoil shall have a pH between 6.5 - 7.3.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Obtain written certification from the General Contractor that final grades to within 0.10' have been established prior to commencing planting operations. Provide for inclusion of all amendments, settling, etc. The Contractor shall be responsible for shaping all planting areas as indicated on the drawings, or as directed by the Landscape Architect.
- B. Inspect site to ensure that it is ready to be seeded and that irrigation system is working for all areas to receive seed.

### 3.2 EXCAVATION

- A. In all hydromulched and seeded areas, the Contractor shall *thoroughly* remove from the construction site all limestone larger than 1/2" in diameter and all heavy clay to a minimum depth of 6". The LA shall verify that this is complete before the Contractor is authorized to proceed with fill of specified topsoil or grading. Scarify subsoil after removal of rock or heavy clay before adding topsoil so as to break up any surface tension.
- B. The Contractor shall thoroughly remove from the construction site all the following particles that are larger than 1/2" in diameter: inorganic select fill, heavy clay, limestone, and construction debris, mortar, concrete, paint, paint thinner, chemicals, weeds, plastic, paper, steel, wire, mortar, masonry, construction debris, and other substances that are harmful to plant growth. Remove the above items to these depths: 6" minimum in turf and seed areas, and 18" minimum in planting beds. The LA shall verify that the above

items are removed before the Contractor is authorized to proceed with fill with specified topsoil or grading.  
**DO NOT PLACE ANY FILL ON CONSTRUCTION DEBRIS.**

- C. After clean-up described above and establishment of subgrade, drag entire planting area with teeth of bucket to scarify subsoil to a depth of 4" to break up surface tension and allow water to pass downwards through the soil.
- D. If soils are rocky or full of limestone or heavy clay, install irrigation system before adding topsoil to keep limestone or clay below imported topsoil and the root zone of plants.
- E. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree holes, plant pits, and planting beds.
- F. Excess soil generated from the planting holes and not used as backfill or in the establishment of the final grades, shall be removed to an on-site location, as approved by the Owner. Unacceptable excess soil shall be removed to an appropriate off-site location.
- G. Protect all areas from excessive compaction when trucking plants or other material to the planting site. Existing vegetation identified by the Landscape Architect to remain, shall be protected from trucking operations during the course of construction.

### 3.3 PRE-PLANT WEED CONTROL

- A. After the irrigation system is operational and approved by the Landscape Architect, apply water for seven (7) to ten (10) calendar days, as needed to achieve weed germination.
- B. If live perennial weeds exist on site at the beginning of the work, spray with a non-selective, systemic contact herbicide, as recommended and applied by an approved, licensed landscape pest control applicator. Leave sprayed plants intact for at least fourteen (14) days to allow systemic kill. Reapply at 2-week intervals until a complete kill is achieved.
- C. Clear and remove these existing, dead weeds by mowing or grubbing off all plant parts at least 1" below the surface of the soil over the entire area to be planted.
- D. Maintain the site weed-free until final acceptance by the Landscape Architect, utilizing mechanical and chemical treatment.

### 3.4 SOIL PREPARATION

- A. Grade Preparation
  1. Immediately before hydromulching, power-rake, scarify, loosen, float and drag the upper 6" of topsoil to bring it to the proper condition. Remove foreign matter larger than 1/2" in diameter. Hydromulch areas shall have topsoil that is light and fluffy after preparation.
  2. If there is not sufficient existing approved topsoil on site, apply imported topsoil as specified in Section 2, MATERIALS, to achieve finish grade. If required, import specified and approved topsoil to achieve depth of (6") depth in all seeded areas.
  3. Amendments: Apply pH Soil Doctor granular Humate at a rate of 500 lbs. per acre directly into slurry.
  4. Fine Grading: After tillage and cleaning, all areas to be planted shall be leveled, fine graded, and drag with a weighted spike harrow or float drag. The required result shall be the elimination of ruts or depressions that would cause water to stand or pond immediately after rainfall or operation of the lawn irrigation system, humps, and objectionable soil clods. This shall be the final soil preparation step to be completed before the commencement of fertilizing and planting.
  5. If the prepared grade is eroded or compacted by rainfall prior to fertilizing, rework the surface to specified condition.
  6. Hydromulch tp be placed after final grade is approved in a timely manner not to exceed a 48-hour period from time of approval to hydromulching.
- B. Spreading of Topsoil:
  1. Topsoil and subgrade shall be damp when topsoil is spread. Top of subsoil shall be scarified and loose, not a hardpan before adding topsoil.
  2. Areas to be seeded shall be top-soiled to a minimum depth of six inches (6"), compacted measure. Provide additional topsoil depths as required to construct the grades indicated on the Drawings. Topsoil shall be compacted to 85%, determined in accordance with ASTM: D 1557. Onsite topsoil is to be used unless it is not available, or is more than 25% clay, or is more than 10% limestone, or is rocky.

### 3.5 HYDROMULCHING

- A. Apply seed via Hydromulch only (not via drill box or hand-spreading) during the periods indicated below unless otherwise approved by the Landscape Architect. Do not sow seed when weather conditions are unfavorable, such as during drought, rain, extreme cold or heat, or high winds. All seed shall be pre-treated at seed supplier with Root Inoculant (See Section 2.1C). Ship and plant seed immediately.
- B. Hydromulching is much preferred over drill box or spreader. However, under certain circumstances, and if approved in writing by Landscape Architect, and if site is large enough and allows room for a tractor, the Landscape Architect may approve seeding using equipment such as cultipacker seeders (preferred), grass seed drill, or wildflower seeder. Seeds shall be evenly installed in multiple passes to a depth of  $\frac{1}{4}$ " -  $\frac{1}{2}$ " under the surface of the soil at the rate specified on the plans.
- C. Warm season turf grasses: Apply between April 15 and September 1, or when the ground temperature is above 65 degrees Fahrenheit.
- D. Cool season turf grasses: Apply between September 1 and March 15, when temperatures are above 40 degrees Fahrenheit.
- E. Native Grass Seed Mixes:
  - 1. Without irrigation: Sow between March 1 and May 30.
  - 2. With irrigation: Sow from March 1 to Sep 15 –(do not irrigate until after Apr. 1)
- F. Native Wildflower Seed Mixes: Sow between September 15 and Nov 15.
- G. If seeding cannot occur within the specified period; an alternative will be proposed by the Contractor for approval by Landscape Architect.
- H. For seeded turfgrasses areas only - apply fertilizer (see section 2.1 F) with specified prescriptive agronomic formulations recommended in soil test. Hydromulch turf seed at a rate of 300 lbs. per acre over properly prepared surfaces. Confirm loading rates with equipment manufacturer.
- I. Do not apply seed onto saturated soils or substrates.
- J. Do not apply seed if rain is anticipated within 48 hours.
- K. Prior to seeding, ensure that all soil shall be smooth, loose, and fluffy to a depth of 6".
- L. Hydromulching: All seeded areas are to be sprayed with a slurry using conventional Hydro-Mulch equipment as manufactured by the Bowie Machine Works, or an approved equal. See Section 2.1, HYDROMULCHING for manufacturers of materials. The hydromulch slurry shall be thoroughly mixed with seed and applied at the rate of:
  - 1. Seed: Variety and rate as called out on plans.
  - 2. Hydromulch: 46 pounds per one thousand 1,000 SF (2,000 pounds per acre)
  - 3. Water: 23 gallons per 1,000 square feet (1,000 gallons per acre).
  - 4. Granular humate soil amendment: (10) lbs. per 1000 SF (435 pounds per acre)
  - 5. Fertilizer: Apply 1200 lbs. per acre or 28 lbs. per 1000 sq. ft.
- M. Strictly comply with equipment manufacturer's installation instructions and recommendations. Use approved hydro-spraying machines with fan-type nozzle (50-degree tip).
  - 1. To achieve optimum soil surface coverage, apply Hydromulch from opposing directions downward to soil surface.
  - 2. Use pressure of sprayer to force seed downward, 1/8" deep into soil.
  - 3. Apply evenly to achieve 75% minimum cover.
  - 4. Rough surfaces (rocky terrain, cat tracks and ripped soils) may require higher application rates to achieve specified cover.
  - 5. Slope interruption devices or water diversion techniques are recommended when slope lengths exceed 25 feet (8 m). Maximum slope length is for product applications on a 4H:1V slope. For application on steeper slopes, slope interruption lengths may need to be decreased based on actual site conditions.
  - 6. Do not install in channels or areas with concentrated water flow. No chemical additives with the exception of products listed above should be added to slurry.
- N. Water thoroughly and immediately with a fine mist until soil is soaked to a depth of 3". Maintain soil in a moist condition until seeds have sprouted and reached a height of 1". Water thereafter at least once every 7 days unless natural rainfall has provided equivalent watering.

### 3.6 CLEAN-UP

- A. After all planting operations have been completed, remove all trash, excess soil, empty plant containers, pallets, ties, rubbish, and all debris associated with this contract from the site. All scars, ruts, trench settlement, or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. The Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site, once a week, or the last working day of each week. All trash shall be removed completely from the site.
- B. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition. All walks shall be left in a clean and safe condition.
- C. Excess topsoil not required for lawns or planting shall be stockpiled on site for future use as directed by the Owner's representative.
- D. Repair existing lawns damaged by operations under the contract. Repair shall include finish grading, seeding as required to match existing grade and lawn, and maintenance of repaired areas.

### 3.7 OBSERVATION SCHEDULE

- A. The Contractor shall be responsible for notifying the Landscape Architect in advance for the following site visits, according to the time indicated:
  - 1. Pre-job Conference - 7 days
  - 2. Final grade review - 2 days
  - 3. Seed material review - 2 days
  - 4. Soil Preparation and planting operations - 2 days
  - 5. Pre-maintenance - 7 days
  - 6. Final inspection - 7 days
- B. When observations are conducted by someone other than the Landscape Architect, the Contractor shall show evidence, in writing, of when and by whom these observations were made.
- C. NO site visits shall commence without all items noted in previous Observation Reports either completed or remedied unless such compliance has been waived by the Owner. Failure to accomplish punch list tasks or prepare adequately for desired inspections shall make the Contractor responsible for reimbursing the Landscape Architect at his current billing rates per hour, portal to portal (plus transportation costs) for the inconvenience. NO further inspections shall be scheduled until this charge has been paid and received.

### 3.8 GUARANTEE

- A. All plant material shall be guaranteed by the contractor for a period of one (1) year from the date of final acceptance.
- B. At the end of the guarantee period the Landscape Architect and Contractor shall inspect plant material. Any plant material under this contract that is dead or of an unsatisfactory growth condition shall be removed and replaced in a timely fashion by the contractor, at no cost to the owner.

### 3.9 ACCEPTANCE OF WORK

- A. The contractor and Landscape Architect shall conduct an on-site inspection of all work and materials to determine compliance of work with the construction documents.
- B. The contractor shall within reasonable means provide the Landscape Architect with sufficient data to demonstrate compliance with the construction documents.
- C. The contractor shall be notified in writing of any non-conforming items, which are to be corrected (punch-list).
- D. The contractor and Landscape Architect shall conduct an on-site inspection to verify completeness of punch list items.
- E. Acceptance of work by the Owner shall begin upon verifying completion of punch list items and receipt of all deliverable items to Owner including letter of guarantee; release of liens waiver, record drawings denoting deviations from contract drawings, product data and maintenance guide.
- F. The contractor shall receive written notification of date of final acceptance and ending date of required guarantee periods from the Landscape Architect.

### 3.10 90 DAY MAINTENANCE

- A. The maintenance period shall commence when the Notice of Substantial Completion is issued and shall continue as required for a period of 90 days.
- B. Immediately after hydromulching, the area shall be protected against traffic or other use by erecting barricades as needed, and by placing approved warning signs at appropriate intervals.
- C. Contractor shall touch-up hydromulch areas as required to achieve full coverage at no cost to Owner.
- D. Mow turf grasses only (not wildflower or native grass areas) during establishment only for the purpose of weed control and to promote quicker spreading.
  - 1. Mow Bermuda and Zoysia Grass to a 2" height.
  - 2. Mow at least once a week in the growing season once turf is rooted and growing.
- E. Fill any depressions, settlement, or washouts that occurs within 90 days following installation. Reseed bare spots that occur during the maintenance period as directed by the Landscape Architect at no cost to Owner.
- F. Keep lawns clean and protected from damage during the maintenance period. Debris that accumulates shall be removed from the site. Promptly repair damaged lawns except as provided in Section 1.9, GUARANTEE AND REPLACEMENT.
- G. Irrigate as required to supplement natural rainfall so that all lawn areas receive sufficient water for normal plant growth. Furnish all irrigation equipment needed for watering and be responsible for securing adequate supply of water if an automatic irrigation system does not exist, is not operating or is damaged.
- H. A second fertilizer application shall be made 60 days after installation to turfgrasses. The specified fertilizer shall be a ratio of 15-5-10 applied at 800 pounds per acre.

END OF SECTION



SECTION 32 92 23

SOD

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

The requirements of the "General Conditions of the Contract" shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

- A. Furnish all labor, material, equipment, and services necessary to provide all landscape sodding, and sprigging work, complete in place, as shown on the drawings and as specified.
- B. Work specified in this Section: The work includes, but is not necessarily limited to:
  - 1. Soil preparation
  - 2. Fine grading
  - 3. Sodding (Solid rolled Sod)
  - 4. Clean-up
  - 5. Maintenance
- C. Related work in other Sections:
  - 1. 32 84 00 - PLANTING IRRIGATION
  - 2. 32 93 00 - TREES, SHRUBS, AND GROUNDCOVERS
- D. Definition: The term of "Landscape Architect" shall refer to Teague Nall and Perkins, Inc., 5237 N. Riverside Drive, Suite 100, Fort Worth, Texas 76137.
- E. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
  - 1. American Society for Testing and Materials (ASTM): D 1557 Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb. (4.54 kg) Rammer and 18 in. (457mm) Drop.

1.3 SUBMITTALS

- A. Samples and Product Information: Representative samples or product information of the following materials shall be provided to the Landscape Architect from the supply source that is to be used for turf areas:
  - 1. Topsoil
  - 2. Soil Amendments
  - 3. Fertilizer: specifications and guaranteed analysis.
  - 4. Biological Amendments: ingredients, chemical analysis, and manufacturer.
  - 5. Sod certification documentation to include the following:
    - a. Kind – Bermuda 419, Common Bermuda, St. Augustine, etc.
    - b. Variety –Bermuda 419, etc.
    - c. Lot Number – If applicable
    - d. Record of square feet of sod shipped.
    - e. Bill of Lading / Invoice # - This is an invoice number that can be referenced to the purchaser of the shipment.
    - f. Field # - the field number references the harvested grass to the production field. The field number must be the same as on the certification application and field inspection report.
    - g. Harvest Date – Record the date the grass was harvested.
    - h. Grower Name and Address- Record the production company name and address. Use of a stamp is acceptable if it shows on all copies.
- B. Construction Schedule: At least two weeks prior to start of work, submit sodding schedule.

- C. Maintenance: Submit three copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of the lawns for an entire year. Submit prior to Notice of Substantial Completion. See PART 3, 90 DAY MAINTENANCE.
- D. Chemicals: Submit products, rates of application, and anticipated uses of any pesticides, herbicides, and fumigants.

#### 1.4 QUALITY ASSURANCE

- A. Contractor's Qualifications
  - 1. The work of this section shall be performed by a Contractor specializing in sodding or landscape installations.
  - 2. The Contractor shall have successfully completed at least 5 installations of this type, size, and complexity in the last four years.
- B. Lawn materials shall comply with all government regulations prevailing at the supply source and the job site.
- C. Fertilizers; Mixed Commercial. Federal Specification: 0-F-241D

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Digging Sod
  - 1. Do not dig sod at the nursery or other approved source until ready to transport sod to the project site or approved storage location.
  - 2. Before stripping, sod shall be mowed at a uniform height of 2".
  - 3. Sod to be cut and delivered in rolled widths.
  - 4. Cut sod to specified thickness and to standard width and length desired.
- B. Transporting Sod
  - 1. Sod transported to the project in open vehicles shall be covered with tarps or other suitable covers securely fastened to the body of the vehicle to prevent injury to the sod. Closed vehicles shall be adequately ventilated to prevent overheating of the sod. Evidence of inadequate protection against drying out in transit shall be cause for rejection.
  - 2. Sod shall be kept moist, fresh, and always protected. Such protection shall encompass the entire period during which the sod is in transit, being handled, or in temporary storage.
  - 3. Transporting sod in excess of 20 miles from the site shall be done during evening, night, early morning hours during summer months
  - 4. Upon arrival at the temporary storage location or the site of the work, sod shall be inspected for proper shipping procedures. Should the roots be dried out, the Landscape Architect will reject the sod. When sod has been rejected, the Contractor shall remove it at once from the area of the work and replace it at no cost to Owner.
  - 5. Unless otherwise authorized by the Landscape Architect, the Contractor shall notify the Landscape Architect at least 48 hours in advance of the anticipated delivery date of sod. A legible copy of the invoice, showing species and variety of sod included for each shipment shall be submitted to the Landscape Architect.
  - 6. Certificate of Inspection when required must accompany each sod shipment.
- C. Handling and Storage of Sod
  - 1. No sod shall remain in temporary storage over 30 hours, and less time may be required during extremely high temperatures.
  - 2. Sod shall be kept moist and shall be stored in a compact group to prevent drying out or freezing.
  - 3. Contractor shall take extreme care in the handling of sod material to avoid breaking or tearing strips. Sod that has been damaged by poor handling may be rejected by the Landscape Architect.

#### 1.6 JOB CONDITIONS

- A. Do not install sod on saturated, excessively dry, or frozen soil.
- B. Sod installation shall be subject to suitability of the weather and other conditions affecting sod growth.
- C. Planting season may be extended only with the written permission of the Landscape Architect.

#### 1.7 SAMPLES AND TESTS

- A. The Landscape Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. The Contractor shall furnish samples upon request by the Landscape Architect. Rejected materials shall be immediately removed from the site at the Contractor's expense. Cost of the testing of materials not meeting specifications shall be paid by the Contractor.
  - B. After rough grading is complete, Contractor shall order and pay for a soil test which includes recommendations. Take a minimum of one soil test per 10 acres - or more as site conditions mandate. Take approximately 15 cores from each uniform soil area. Mix them thoroughly in a clean plastic or paper container. Fill the soil sample bag one-third to one-half full from this representative sample. Acceptable labs are:
    - 1. TPS Lab: "SO-05, TPSL® Plant Natural™ Soil Test + LOI Organic Matter + Solvita®"
    - 2. A&L Plains Agricultural Laboratories: "Basic Test S2" and "Basic Test S3" and "Organic Matter – by Combustion" (all three tests are required)
  - C. Submit results to Landscape Architect for adjustment to soil amendments and fertilizers.
- 1.8 MAINTENANCE
- A. All stored plant material shall be maintained in a healthy, vigorous condition by the Contractor. Maintenance includes, but is not necessarily limited to, mowing, weeding, edging, watering, trash removal, street and gutter cleaning, erosion repair, removal of siltation in drainage areas, and insect and disease chemical applications. The storage area shall be mowed, weeded, and trimmed weekly during the course of construction and the life of the storage area.
  - B. Within the limits of construction, the site shall be maintained in a neat, well-kept appearance by the Contractor. Maintenance includes, but is not necessarily limited to, mowing, weeding, edging, watering, trash removal, street and gutter cleaning, erosion repair, removal of siltation in drainage areas, and insect and disease chemical applications.
  - C. Contractor shall maintain plant material as described in PART 3, 90-DAY MAINTENANCE.
- 1.9 GUARANTEE AND REPLACEMENT
- A. Warrant all lawns for a period of one year from date of Notice of Substantial Completion, to be at least the quality and conditions as at Final Acceptance. Promptly re-sod unacceptable areas during the warranty period as directed by the Landscape Architect.
  - B. Lawn shall be uniform in color, grass type, leaf texture, leaf and root density, and free from weeds, diseases, and other visible imperfections at acceptance.
  - C. Damage to the irrigation system by other trades or persons (such as shutting off of water or power to the irrigation system) shall not affect the warranty. This means that, especially in the warm season, the Contractor shall make daily visits to the site to inspect and repair the irrigation system up until final acceptance.
- 1.10 FINAL INSPECTION AND ACCEPTANCE
- A. The Landscape Architect will inspect all work for Substantial Completion upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.
  - B. Acceptance will be based on establishment of a uniform stand of turf grass, defined as coverage of specified grass at a density of 95 percent coverage, with no bare spots greater than one square foot, free of weeds, undesirable grass species, disease, and insects. For grass varieties selected, allow a minimum of 90 days for establishment and maintenance.
  - C. In areas that are grassed and not irrigated, grass will be established and the Landscape Architect will inspect the work for Substantial Completion upon written request from the Contractor. Unirrigated grass areas must be fully established to the same standard as fully irrigated grass areas.
  - D. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Landscape Architect, the Landscape Architect will recommend to the Owner that the work of this Section be accepted.

## PART 2 – MATERIALS

### 2.1 SOLID SOD

- A. Sod shall be as specified on plans, nursery grown on cultivated mineral agricultural soils. Sod shall have been mowed regularly and carefully and otherwise maintained from planting to harvest. Sod must be mowed two (2) days prior to cutting.
- B. All sod shall be "Certified Sod" from a licensed and certified sod producer. Provide test results from a plant pathology lab to LA for approval before purchase.
- C. For sports fields, or if called out on plans, use only rolled solid sod.
- D. Thickness of Cut: Sod shall be cut to have minimum pad thickness of:
  - 1. Bermuda Grass: 3/4" minimum thickness, with plus/ minus 1/8" tolerance
  - 2. St. Augustine, Buffalo, and Zoysia Grass: 1" thick, with plus/ minus 1/8" tolerance
- E. Width and Length of Sod: Maximum allowable deviation from standard widths and lengths shall be plus or minus 1/2" on width, and plus or minus 5% on length. Broken strips and torn or uneven ends will be rejected.
- F. Strength of Sod Strips: Sod strips shall be strong enough to support their own weight and retain their size and shape if suspended vertically when grasped in the upper 10% of the section.
- G. Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively wet or dry) may adversely affect its survival.
- H. Sod shall consist of live growing plants secured from sources which have dense, thickly matted root system throughout the soil of the sod for a minimum of one inch. Sod shall be free of weeds or other varieties of grasses.
- I. Reject any Sod whose roots are dried because of sun or wind. The landscape architect has the right to reject any or all of sod due to lack of care, improper cutting, or other agronomic problems.
- J. Time Limitations: Sod shall be harvested, delivered, and transplanted within a 30-hour period unless a suitable preservation method is approved by the Landscape Architect prior to delivery. Sod not transplanted within this period shall be inspected and approved by the Landscape Architect prior to its installation.
- K. Thatch: Sod shall be relatively free of thatch. A maximum on 1/2" (uncompressed) thatch will be permitted.
- L. Sod shall be free of diseases, harmful insects, nematodes, soil borne diseases, nutsedge, and all other grassy and broadleaf weeds.
- M. Fertilizer for Sod areas: Itaipollina 4-4-4 or approved equal. Product shall be an OMRI registered organic fertilizer of a guaranteed analysis, 4-4-4, containing no less than 41% total organic Carbon, 71% organic matter, and 5% humic acid. Contact: Allen Olson (817) 368-8615, allen@gdrsistemas.net

## 2.2 TOPSOIL

- A. All existing topsoil stripped for this work and suitable for reuse shall be stored on site as directed by the Landscape Architect. Dispose of all excess topsoil on the site as directed by the Landscape Architect.
- B. Utilize on-site and imported topsoil to provide a minimum six-inch (6") layer of approved soil for sod installation as specified and indicated on the Drawings.
- C. If on-site topsoil is not available, imported topsoil shall be used as indicated on the drawings and as follows:
  - 1. Imported top soil shall be natural, loose, fertile, friable, screened agricultural soil, having characteristics of representative productive soils in the vicinity, and obtained from naturally well-drained areas. Imported soil for sod areas to be: "Enriched Top Soil", by Soil Building Systems, (972) 831-8181, or approved equal, submit a 1-quart package with supplier label attached to sample.
  - 2. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing the 2.0-millimeter sieve. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECe) of the saturation extract of this soil shall not exceed 3.0 millimhos per centimeter at 25 degrees centigrade. The boron content shall be no greater than 1 part per million as measured on the saturation extract. In order to ensure conformance, samples of the import soil shall be submitted to the laboratory for analysis prior to, and following, backfilling.
  - 3. Imported top soil shall be free of insects, harmful nematodes, soil-borne diseases, toxins, heavy clay, select fill, inorganic subsoils, heavy metals, trash, petroleum by-products, rocks over 1" diameter, rubble, roots, nutgrass, or weeds, or weed seeds.
  - 4. Imported Topsoil shall have a pH between 6.5 - 7.3.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Obtain written certification from the General Contractor that final grades to within 0.10' have been established prior to commencing planting operations. Provide for inclusion of all amendments, settling, etc. The Contractor shall be responsible for shaping all planting areas as indicated on the drawings, or as directed by the Landscape Architect.
- B. Inspect site to ensure that it is ready to be sodded and that irrigation system is working for all areas to receive sod.

### 3.2 EXCAVATION

- A. In all sod areas, the Contractor shall *thoroughly* remove from the construction site all limestone larger than 1/2" in diameter and all heavy clay to a minimum depth of 6". The LA shall verify that this is complete before the Contractor is authorized to proceed with fill of specified topsoil or grading. Scarify subsoil after removal of rock or heavy clay before adding topsoil so as to break up any surface tension.

The Contractor shall thoroughly remove from the construction site all the following particles that are larger than 1/2" in diameter: inorganic select fill, heavy clay, limestone, and construction debris, mortar, concrete, paint, paint thinner, chemicals, weeds, plastic, paper, steel, wire, mortar, masonry, construction debris, and other substances that are harmful to plant growth. Remove the above items to these depths: 6" minimum in turf and seed areas, and 18" minimum in planting beds. The LA shall verify that the above items are removed before the Contractor is authorized to proceed with fill with specified topsoil or grading. **DO NOT PLACE ANY FILL ON CONSTRUCTION DEBRIS.**

- B. After clean-up described above and establishment of subgrade, drag entire planting area with teeth of bucket to scarify subsoil to a depth of 4" to break up surface tension and allow water to pass downwards through the soil.
- C. If soils are rocky or full of limestone or heavy clay, install irrigation system before adding topsoil so as to keep limestone or clay below imported topsoil and the root zone of plants.
- D. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree holes, plant pits, and planting beds.
- E. Excess soil generated from the planting holes and not used as backfill or in the establishment of the final grades, shall be removed to an on-site location, as approved by the Owner. Unacceptable excess soil shall be removed to an appropriate off-site location.
- F. Protect all areas from excessive compaction when trucking plants or other material to the planting site. Existing vegetation identified by the Landscape Architect to remain, shall be protected from trucking operations during construction.

### 3.3 PRE-PLANT WEED CONTROL

- A. After the irrigation system is operational and approved by the Landscape Architect, apply water for seven (7) to ten (10) calendar days, as needed to achieve weed germination.
- B. If live perennial weeds exist on site at the beginning of the work, spray with a non-selective, systemic contact herbicide, as recommended and applied by an approved, licensed landscape pest control applicator. Leave sprayed plants intact for at least fourteen (14) days to allow systemic kill. Reapply at 2-week intervals until a complete kill is achieved.
- C. Clear and remove these existing, dead weeds by mowing or grubbing off all plant parts at least 1" below the surface of the soil over the entire area to be planted.
- D. Maintain the site weed-free until final acceptance by the Landscape Architect, utilizing mechanical and chemical treatment.

### 3.4 SOIL PREPARATION

- A. Grade Preparation
  - 1. Immediately before sodding, power-rake, scarify, loosen, float and drag the upper 6" of topsoil to bring it to the proper condition. Remove foreign matter larger than 1/2" in diameter. Sod areas shall have topsoil that is smooth and compacted to 85% after preparation.

2. If there is not sufficient existing approved topsoil on site, apply imported topsoil as specified in PART 2, MATERIALS, to achieve finish grade. If required, import topsoil to achieve depth of (6") of approved topsoil in all turf areas.
3. Fine Grading: After tillage and cleaning, all areas to be planted shall be leveled, fine graded, and drug with a weighted spike harrow or float drag. The required result shall be the elimination of ruts or depressions that would cause water to stand or pond immediately after rainfall or operation of the lawn irrigation system, humps, and objectionable soil clods. This shall be the final soil preparation step to be completed before the commencement of fertilizing and planting.
4. If the prepared grade is eroded or compacted by rainfall prior to fertilizing, rework the surface to specified condition.
5. Sod to be placed after final grade is approved in a timely manner not to exceed a 48-hour period from time of approval to laying of sod.

B. Spreading of Topsoil:

1. Topsoil and subgrade shall be damp when topsoil is spread. Top of subsoil shall be scarified and loose, not a hardpan before adding topsoil.
2. Areas to be sodded shall be top-soiled to a minimum depth of six in. (6"), compacted measure. Provide additional topsoil depths as required to construct the grades indicated on the Drawings. Topsoil shall be compacted to 85%, determined in accordance with ASTM: D 1557. Onsite topsoil is to be used unless it is not available, or is more than 25% clay, or is more than 10% limestone, or is rocky.

C. Fertilizing for Sod Areas:

1. Till specified fertilizer (along with any amendment) into the top 1" of area to receive sod. Work fertilizer into the soil to a depth of ½"-1" after fine grading & not more than 2 days prior to grass planting. Cultivating equipment shall be set so the fertilizer will not penetrate the soil more than 1 inch. Do not apply fertilizer when there is a possibility of rain before lawn areas can be sodded.
2. Uniformly distribute granular sod fertilizer by mechanical means at the rate of 1200 lbs. per acre or 28 lbs. per 1000 sq. ft., See PART 2, SOLID SOD.
3. Irrigate soil after fertilizer application and 1- 4 hours prior to laying sod.

### 3.5 SODDING

A. Weather Conditions

1. Schedule work for periods of favorable weather.
2. Do not place Sod on days that, in the judgment of the Landscape Architect, are too hot, sunny, dry, cold, wet, or windy for optimal growth.

B. Placement Pattern

1. The first row shall be laid in a straight line with subsequent rows parallel to the first row and tightly abutting each other.
2. Lateral joints shall be staggered. Care shall be exercised to ensure that the sod is neither stretched nor overlapped. Joints must be butted tightly to prevent voids that could permit air to dry out roots.
3. Immediately after placing, sod shall be pressed firmly into contact with sod bed by tamping or rolling to eliminate air pockets.
4. When on slopes steeper than 4 to 1, sod shall be secured by galvanized pins, wood pegs or other methods approved by the Landscape Architect.
5. Sand joints and top dress turf with topdressing sand as necessary to provide a smooth uniform finished surface.
6. Immediately after sodding operations have been completed, entire surface shall be compacted with a roller or other approved equipment. The completed area after sodding shall be uniformly even, firm, and true to finished grade lines.

C. Rolled Sod

1. For sports fields, or if called out on plans, use rolled solid sod.
2. Runs of rolled sod shall be maximized to minimize small pieces. Lay sod to avoid small or skinny pieces.
3. A bobcat and/or tractor with extra-wide tires and a "big roll" attachment shall be used to lay the rolls of sod.
4. Plastic netting shall be removed as sod is rolled out and properly disposed of upon installation as shown in the following photo:



- D. Watering:
  - 1. Provide an adequate supply of water to keep the sod thriving at the site prior to and during transplanting of the sod.

### 3.6 CLEAN-UP

- A. After all planting operations have been completed, remove all trash, excess soil, empty plant containers, pallets, ties, rubbish, and all debris associated with this contract from the site. All scars, ruts, trench settlement, or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. The Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site, once a week, or the last working day of each week. All trash shall be removed completely from the site.
- B. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition. All walks shall be left in a clean and safe condition.
- C. Excess topsoil not required for lawns or planting shall be stockpiled on site for future use as directed by the Owner's representative.
- D. Repair existing lawns damaged by operations under the contract. Repair shall include finish grading and sodding as required to match existing grade and lawn, and maintenance of repaired areas.

### 3.7 OBSERVATION SCHEDULE

- A. The Contractor shall be responsible for notifying the Landscape Architect in advance for the following site visits, according to the time indicated:
  - 1. Pre-job Conference - 7 days
  - 2. Final grade review - 2 days
  - 3. Sod material review - 2 days
  - 4. Soil Preparation and planting operations - 2 days
  - 5. Pre-maintenance - 7 days
  - 6. Final inspection - 7 days
- B. When observations are conducted by someone other than the Landscape Architect, the Contractor shall show evidence, in writing, of when and by whom these observations were made.
- C. NO site visits shall commence without all items noted in previous Observation Reports either completed or remedied unless such compliance has been waived by the Owner. Failure to accomplish punch list tasks or prepare adequately for desired inspections shall make the Contractor responsible for reimbursing the Landscape Architect at his current billing rates per hour, portal to portal (plus transportation costs) for the inconvenience. NO further inspections shall be scheduled until this charge has been paid and received.

### 3.8 GUARANTEE

- A. All plant material shall be guaranteed by the contractor for a period of one (1) year from the date of final acceptance.

- B. At the end of the guarantee period the Landscape Architect and Contractor shall inspect plant material. Any plant material under this contract that is dead or of an unsatisfactory growth condition shall be removed and replaced in a timely fashion by the contractor, at no cost to the owner.

### 3.9 ACCEPTANCE OF WORK

- A. The Contractor and Landscape Architect shall conduct an on-site inspection of all work and materials to determine compliance of work with the construction documents.
- B. The Contractor shall, within reasonable means, provide the Landscape Architect with sufficient data to demonstrate compliance with the construction documents.
- C. The Contractor shall be notified in writing of any non-conforming items, which are to be corrected (punch-list).
- D. The Contractor and Landscape Architect shall conduct an on-site inspection to verify completeness of punch list items.
- E. Acceptance of work by the Owner shall begin upon verifying completion of punch list items and receipt of all deliverable items to Owner including letter of guarantee; release of liens waiver, record drawings denoting deviations from contract drawings, product data and maintenance guide.
- F. The Contractor shall receive written notification of date of final acceptance and ending date of required guarantee periods from the Landscape Architect.

### 3.10 90 DAY MAINTENANCE

- A. The maintenance period shall commence when the Notice of Substantial Completion is issued and shall continue as required for a period of 90 days.
- B. Immediately after sodding, the area shall be protected against traffic or other use by erecting barricades as needed, and by placing approved warning signs at appropriate intervals.
- C. Contractor shall touch-up sod areas as required to achieve 100% coverage at no cost to Owner.
- D. Mow turf grasses only (not wildflower or native grass areas) during establishment only for the purpose of weed control and to promote quicker spreading.
  - 1. Mow Bermuda and Zoysia Grass to a 2" height.
  - 2. Mow St Augustine Grass to a 4" height.
  - 3. Mow at least once a week in the growing season once turf is rooted and growing.
- E. Fill any depressions, settlement, or washouts that occurs within 90 days following installation. Re-sod bare spots that occur during the maintenance period as directed by the Landscape Architect at no cost to Owner.
- F. Keep lawns clean and protected from damage during the maintenance period. Debris that accumulates shall be removed from the site. Promptly repair damaged lawns except as provided in PART 1, GUARANTEE AND REPLACEMENT.
- G. Irrigate as required to supplement natural rainfall so that all lawn areas receive sufficient water for normal plant growth. Furnish all irrigation equipment needed for watering and be responsible for securing adequate supply of water if an automatic irrigation system does not exist, is not operating or is damaged.
- H. A second fertilizer application shall be made 60 days after installation to turfgrasses. The specified fertilizer shall be applied at 800 pounds per acre or 18 lbs. per 1,000 SF., See PART 2, SOLID SOD.

END OF SECTION



SECTION 32 93 00

TREES, SHRUBS, AND GROUNDCOVERS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

The requirements of the "General Conditions of the Contract" shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

- A. Furnish all labor, material, equipment, and services necessary to provide all landscape planting, complete in place, as shown on the drawings and as specified.
- B. Work specified in this Section: The work includes, but is not necessarily limited to:
  - 1. Soil preparation
  - 2. Fine grading
  - 3. Metal edging
  - 4. Planting
  - 5. Staking and Guying
  - 6. Clean-up
  - 7. Maintenance
- C. Related work in other Sections:
  - 1. 32 84 00 - PLANTING IRRIGATION
  - 2. 32 92 23 - SOD
- D. Definition: The term "Landscape Architect" or "LA" shall refer to Teague Nall and Perkins, Inc. 5237 N. Riverside Drive, Suite 100, Fort Worth, Texas 76137.

1.3 SUBMITTALS

- A. Samples and Product Information: Representative samples or product information of the following materials shall be provided to the Landscape Architect from the supply source that is to be used for Trees, Shrubs, and Groundcover areas: Plant type and nursery with clear pictures showing a measuring rod and person for scale.
- B. Samples and product information: one-quart size sample in a quart-size baggie, list of ingredients, guaranteed chemical analysis, and manufacturer for:
  - 1. Topsoil
  - 2. Soil Amendments and Compost
  - 3. Fertilizer
  - 4. Weed Barrier for DG (cut-sheet only)
  - 5. Decomposed Granite
  - 6. Mulch
  - 7. Trip/ Delivery tickets on all above items to verify delivery date, source, type, and quantity
- C. Construction Schedule: At least two weeks prior to start of work, submit planting schedule.
- D. Maintenance: Submit three copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of the landscape for an entire year. Submit prior to Notice of Substantial Completion. See PART 3, 90 DAY MAINTENANCE.

- E. Chemicals: Submit products, rates of application, and anticipated uses of any pesticides, herbicides, and fumigants.

#### 1.4 QUALITY ASSURANCE

##### A. Qualifications

1. The Contractor shall be a company specializing in landscape installation.
2. The Contractor shall have successfully completed at least 5 installations of this type, size, and complexity in the last four years.

##### B. All materials and work shall comply with applicable sections of the following references:

1. American Association of Nurserymen, Inc., (AAN) Standard: American Standard for Nursery Stock (ANSI Z60.1, Most recent addition).
2. ANSI A 300 – Standard Practices for Tree, Shrub and other Woody Plant Maintenance, most current edition and parts.
3. Florida Grades and Standards for Nursery Stock, current edition (Florida Department of Agriculture, Tallahassee FL).
4. Interpretation of plant names and descriptions shall reference the following documents. Where the names or plant descriptions disagree between the several documents, the most current document shall prevail.
  - a. USDA - The Germplasm Resources Information Network (GRIN) <http://www.ars-grin.gov/npgs/searchgrin.html>
  - b. Manual of Woody Landscape Plants; Michael Dirr; Stipes Publishing, Champaign, Illinois; Most Current Edition.
5. Pruning practices shall conform to recommendations "Structural Pruning: A Guide For The Green Industry" most current edition; published by Urban Tree Foundation, Visalia, California.
6. Glossary of Arboricultural Terms, International Society of Arboriculture, Champaign IL, most current edition.
7. Fertilizers; Mixed Commercial. Federal Specification: 0-F-241D

##### C. Source Quality Control:

1. Submit documentation to the Landscape Architect within ten (10) calendar days after award of the Contract that all plant material is available. The Contractor shall be responsible for all material listed on the plant list. Any substitutions due to unavailability must be requested, in writing, prior to confirmation of ordering. All material shall be subject to inspection by the Landscape Architect at any time after confirmation of ordering.
2. Plants shall be subject to inspection and approval of the Landscape Architect at the place of growth, or upon delivery for conformity to the specifications. Such approval shall not impair the right of inspection and/ or rejection during the progress of the work. Inspection and tagging of plant material by the Landscape Architect is for design intent only and does not constitute the Landscape Architect's approval of the plant materials in regard to their health and vigor as specified in PART 2, Plant Material.
3. The health and vigor of the plant material is the sole responsibility of the Contractor. Submit written request for inspection of plant material at the place of growth to the Landscape Architect. Written requests shall state the place of growth and quantity of plants to be inspected. The Landscape Architect reserves the right to refuse inspection at this time if, in his judgment, a sufficient quantity of plants is not available for inspection.
4. The Contractor shall submit specifications of any item being used on site, upon the request of the Landscape Architect.
5. The Contractor shall obtain and pay for all permits required by local codes.
6. Ordinances and Regulations: All local, municipal, and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and make a part of these

specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations, or requirements of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

##### A. Delivery:

1. Deliver fertilizer to the site in the original, unopened containers bearing the manufacturer's guaranteed chemical analysis, name, trade mark, and conformance to State law.
2. The Contractor shall furnish the Landscape Architect with copies of receipts for all amendments specified in PART 2, MATERIALS, or amended by the Soils Report specified in PART 3, SOIL PREPARATION.
3. Deliver all plants with legible identification labels.
  - a. Label trees, bundles of containers of like shrubs, or groundcover plants.
  - b. State the correct botanical plant name and size indicated on the plant list, on the drawings.
  - c. Use durable waterproof labels with water-resistant ink which will remain legible for at least 60 calendar days.
4. Protect plant material during delivery to prevent damage to the root ball or desiccation of leaves.
5. Tarp trees and plant material with canvas, or similar material, during delivery of any length, on any open-air transport.
6. Transporting trees in excess of 20 miles from the site shall be done during evening, night, early morning hours during summer months. The Contractor shall routinely stop the transport and water root balls at pre-determined intervals. Intervals shall be in agreement with the Landscape Architect, as determined in advance of the transport.
7. The Contractor shall notify the Landscape Architect seven (7) calendar days in advance of delivery of all plant materials and shall submit an itemized list of the plants in each delivery.

##### B. Storage:

1. An on-site location shall be made available for plant material storage. Security and protection of the storage area shall be the Contractor's responsibility.
2. Store plant material in shade and protect from weather.
3. Maintain and protect plant material not to be planted within four (4) hours in a healthy, vigorous condition.
4. Storage of plant materials shall be neat, orderly, and grouped according to like plants.
5. Plant material, upon delivery, shall be inspected for transport damage, disease, and insect infestation. Any infected material shall be immediately removed from site at Contractor's expense. Notify Landscape Architect in writing upon discovery of any pests.
6. The Contractor shall be responsible for completely restoring the storage area to the original condition prior to final acceptance of construction. Restoration shall occur within seven (7) calendar days of written notification by the Landscape Architect.

- C. Handling: The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of plant materials. Plant materials that have been damaged in any way will be discarded, and if installed, shall be replaced with undamaged materials at the Contractor's expense.

#### 1.6 JOB CONDITIONS

- A. Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice.
- B. Scheduling: Install trees, shrubs, and groundcover before hydraulic seeding or sodding operations are commenced.

#### 1.7 SAMPLES AND TESTS

- A. The Landscape Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. The Contractor shall furnish samples upon request by the Landscape Architect. Rejected materials shall be immediately removed from the site at the Contractor's expense. Cost of the testing of materials not meeting specifications shall be paid by the Contractor.
- B. After rough grading is complete, Contractor shall order and pay for a soil test which includes recommendations. Take a minimum of one soil test per 10 acres - or more as site conditions mandate. Take approximately 15 cores from each uniform soil area. Mix them thoroughly in a clean plastic or paper container. Fill the soil sample bag one-third to one-half full from this representative sample. Acceptable labs are:
  1. TPS Lab: "SO-05, TPSL® Plant Natural™ Soil Test + LOI Organic Matter + Solvita®"
  2. A&L Plains Agricultural Laboratories: "Basic Test S2" and "Basic Test S3" and "Organic Matter – by Combustion" (all three tests are required)
- C. Submit results to Landscape Architect for adjustment to soil amendments and fertilizers.

#### 1.8 MAINTENANCE

- A. All stored plant material shall be maintained in a healthy, vigorous condition by the Contractor. Maintenance includes, but is not necessarily limited to, mowing, weeding, edging, watering, trash removal, street and gutter cleaning, erosion repair, removal of siltation in drainage areas, and insect and disease chemical applications. The storage area shall be mowed, weeded, and trimmed weekly during construction and the life of the storage area.
- B. Within the limits of construction, the site shall be maintained in a neat, well-kept appearance by the Contractor. Maintenance includes, but is not necessarily limited to, mowing, weeding, edging, watering, trash removal, street and gutter cleaning, erosion repair, removal of siltation in drainage areas, and insect and disease chemical applications.
- C. Contractor shall maintain plant material as per PART 3, 90 DAY MAINTENANCE.

#### 1.9 GUARANTEE AND REPLACEMENT

- A. All materials (living and non-living) and workmanship shall be guaranteed for a period of one year after the Date of Acceptance by the Owner. When the work is accepted in parts, the guarantee periods shall extend from each of the partial acceptances to the terminal date of the last guarantee period. Thus, all guarantee periods terminate at one time.
- B. Plants shall be healthy, free of pests and disease, and in flourishing condition at the end of the guarantee period. Plants shall be free of dead and dying branches and branch tips, and shall bear foliage of normal density, size, and color.
- C. Contractor shall promptly replace all dead plants and all plants not in a vigorous, thriving condition, as determined by the Landscape Architect during and at the end of the guarantee period, without cost to the Owner, as soon as weather conditions permit and within the specified planting period. Replacements shall match adjacent specimens of the same species. Replacements shall be subject to all the requirements stated in this Specification. Contractor to make all necessary repairs due to plant replacements. Such repairs shall be done at no cost to the Owner.
- D. The guarantee of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. If a replacement plant is not acceptable during or at the end of the said extended guarantee period, the Owner may elect one more replacement or credit for each item.
- E. Damage to the irrigation system by other trades or persons (such as shutting off of water or power to the irrigation system) shall not affect the warranty. This means that, especially in the warm season, the Contractor shall make daily visits to the site to inspect and repair the irrigation system up until final acceptance.
- F. Scheduling of replacements within a reasonable time shall be as determined by the Owner. In the event of failure to make such repairs or replacements within a reasonable time after receipt of written notice

from the Owner, the Contractor authorizes the Owner to proceed to have said repairs or replacements made at Contractor's expense and Contractor agrees to reimburse Owner within 60 days.

#### 1.10 FINAL INSPECTION AND ACCEPTANCE

- A. At the end of the guarantee period, the Landscape Architect will, upon written notice of end of guarantee period inspect the work for Final Acceptance. Request shall be received at least ten calendar days before the anticipated date for Final Inspection.
- B. Upon completion and reinspection of full repairs or replacements necessary in the judgment of the Landscape Architect at that time, the Landscape Architect will recommend to the Owner that Final Acceptance of the Work of the Section be given.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. The following specified soil amendments and fertilizer are to be used for bid prices basis only. Specific amendments and fertilizer specification will be made after rough grading operations are complete and soil samples are tested by the Laboratory at the Contractor's expense.
- B. All materials shall be of standard, approved, and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original, unopened container bearing the manufacturer's guaranteed analysis. The Contractor shall supply the Landscape Architect with a sample of all supplied materials accompanied by analytical compliance or bearing the manufacturer's guaranteed analysis.
- C. Soil Amendment for shrub and groundcover beds and stand-alone tree planting: "Gumbo Buster", by Soil Building Systems, 972-831-8181, or approved equal. See PART 1, SUBMITTALS.
- D. Fertilizer for Tree, Shrub, and Groundcover Areas: Italtollina 4-4-4 or approved equal. Product shall be an OMRI registered organic fertilizer of a guaranteed analysis, 4-4-4, containing no less than 41% total organic Carbon, 71% organic matter, and 5% humic acid. Contact: Allen Olson (817) 368-8615, allen@gdrsystems.net.
- E. Imported Topsoil shall:
  - 1. Be loose, fertile, friable, screened horticultural soil, having characteristics of representative productive soils in the vicinity, and obtained from naturally well-drained areas. Imported Topsoil for planting beds to be: "Ready-to-Plant", by Soil Building Systems, (972) 831-8181, or approved equal. See PART 1, SUBMITTALS.
  - 2. Include fully composted cotton burrs, local grass, leaves, brush and processed wood fiber and shall add an average of 1.44 lbs. of N, 0.22 lbs. P, and 0.9 lbs. K of pure consumable organic nutrients per 100 square feet for each inch depth added plus minerals and trace elements. Compost shall not include food waste, stable waste, treated lumber, pallets, pine bark, raw manure or mushroom compost waste. Compost shall not include any man-made materials or chemicals. Do not use mixed municipal solid waste compost. Ensure compost does not contain any visible inorganic refuse, other physical contaminants, or any substance considered harmful to plant growth. It must be turned at least 5 times and not exceed a temperature of 160 degrees Fahrenheit. Each turning cycle should not be shorter than 14 days minimum. Supporting compost process documentation should be made available by compost vendor upon request.
  - 3. Be comprised of pH Balanced Compost, select screened soil, and screened non-washed sand.
  - 4. Have 98.5% of media passing through a ½ screen and 99%+ passing through a ¾ inch screen. The imported topsoil will weigh between 1,900 and 2,250 lbs. per cubic yard.
  - 5. Not contain, or be created from, treated lumber, pallets, construction waste, pine bark, straw, raw mulch, raw manure, livestock stable bedding litter/waste, food waste, or mushroom compost waste.
  - 6. Be free of insects, harmful nematodes, soil-borne diseases, toxins, heavy clay, select fill, inorganic subsoils, heavy metals, trash, petroleum by-products, rocks over 1" diameter, rubble, roots, weeds, weed seeds, Clopyralid, or Picloram.

7. Have a pH between 6.0 and 7.0.
  8. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing the 2.0-millimeter sieve. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECe) of the saturation extract of this soil shall not exceed 3.0 millimhos per centimeter at 25 degrees centigrade. The boron content shall be no greater than 1 part per million as measured on the saturation extract. In order to ensure conformance, samples of the import soil shall be submitted to the laboratory for analysis prior to, and following, backfilling.
- F. Plant Material:
1. Name and Variety: Provide plant materials true to name and variety described in Quality Assurance PART 1.
  2. Plants shall be in accordance with the Texas State Department of Agriculture's Regulation for nursery inspections, rules, and ratings.
  3. All plant material shall be No. 1 grade nursery stock or better, grown in accordance with good horticultural practice. Plants shall be free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, or disfigurement. They shall be sound, healthy and vigorous, of uniform growth, typical of the species and variety, well formed, free from irregularities, with the minimum quality conforming to American Standard for Nursery Stock.
  4. Plants indicated as specimen shall be exceptionally heavy, symmetrical, and tightly knit, cultured, to be unquestionably superior in form, branching, compactness, and symmetry.
  5. The minimum acceptable sizes of all plants shall be measured before pruning and with branches in normal position. Unless otherwise designated on the plant list, all plant dimensions shall conform to those listed in ANSI Z60.1, American Standard for Nursery Stock.
  6. Branching point is the distance above ground where balanced branching occurs or where a dimension in trunk appears to form the head of the tree.
  7. Trees shall not have included bark in the crotches of the limbs. Trees with included bark shall be rejected.
  8. Root Treatment: Root treatments on all plants shall conform to the requirements of ANSI Z60.1. Plants shall be dug and prepared for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
  9. Plants furnished in containers shall have the roots well established in the soil mass and shall have growth in the container for at least one growing season. Containers shall be large enough to provide earth root mass of adequate size to support the plant tops being grown.
  10. Container-grown trees shall have a root ball measuring 10" of diameter for each 1" of tree caliper. The tree caliper shall be measured on the trunk, 12" above the finish grade or root flare of the tree. Plants, other than ground covers, over established in the container, as evidenced by pot bound root ends, will not be accepted.
  11. B&B and Collected Plant Material (only permitted if specifically called out on plans) shall have a root ball measuring 12" of diameter for each 1" of tree caliper. The tree caliper shall be measured on the trunk, 12" above the finish grade or root flare of the tree.
  12. If plants are specified as balled and burlapped (B&B), then B&B plants shall have a firm, natural ball of earth of sufficient diameter and depth to encompass the fibrous and feeding root systems necessary for full recovery of the plant. Balls shall be securely wrapped with burlap and bound with cord or a wire basket. Ball sizes shall meet the requirements of the ANSI Z60.1, or as indicated on the Drawings. B&B trees shall have been hardened off, meaning that they shall have been dug 6-52 weeks prior to shipment.
  13. Provide healthy stock, grown in a nursery and reasonably free of die-back, disease, insects, eggs, bores, and larvae. At the time of planting all plants shall have a root system, stem, and branch form that will not restrict normal growth, stability and health for the expected life of the plant.
  14. Plant materials are subject to final approval by the Landscape Architect at the job site.

15. All plants not conforming to the requirements herein specified, shall be considered defective and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site of the work and replaced with new plants at the Contractor's expense. The plants shall be of the species, variety, size, and conditions specified herein or as shown on the drawings. Under no conditions will there be any substitutions of plants or sizes listed on the accompanying plans, except with the expressed, written consent of the Landscape Architect.

G. Plant Root Quality

1. Plant roots shall be normal to the plant type specified. Root observations shall take place without impacting tree health. Root quality at or below the soil line shall comply with the project Root Acceptance details and the following:
  - a. The roots shall be reasonably free of scrapes, broken or split wood.
  - b. The root system shall be reasonably free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Wounds resulting from root pruning used to produce a high quality root system are not considered injuries.
2. A minimum of three structural roots reasonably distributed around the trunk (not clustered on one side) shall be found in each plant. Root distribution shall be uniform throughout the root ball, and growth shall be appropriate for the species. Plants with structural roots on only one side of the trunk (J roots) shall be rejected.
3. The root collar shall be within the upper 2 inches of the substrate/soil. Two structural roots shall reach the side of the root ball near the top surface of the root ball. The grower may request a modification to this requirement for species with roots that rapidly descend, provided that the grower removes all stem girdling roots above the structural roots across the top of the root ball.
4. The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots from nursery production practices.
5. At time of observations and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

H. Staking Materials:

1. Tree support stakes shall be Tree Frog Pro Series above ground guying system or approved equal. (352) 735-7411. Install according to manufacturer's instructions.
2. Size according to:
  - a. Pro 20 – up to 2" caliper trees
  - b. Pro 40 – up to 4" caliper trees
  - c. Pro 60 – up to 6" caliper trees
3. Straps to be 3/4" wide, woven, green polypropylene, 900 lb. break strength, UV resistant strapping, provided by manufacturer.
4. Anchors to be arrowhead-shaped aluminum alloy (HD).
- I. Tree Paint (for Oaks only to prevent spread of Oak Wilt): Tanglefoot Tree Wound Pruning Sealer (emulsified asphalt) or approved equal.
- J. Weed Barrier: Do not use weed barrier in planting beds. Weed Barrier product for DG or gravel or stone areas shall be "Weed Barrier Pro" as supplied by DeWitt Company 1-800-888-9669 or approved equal.
- K. Water: Source furnished by the Contractor, cost and transport of water, as required, by the Contractor.
- L. Mulch: "Fine Cut Hardwood Mulch" by Soil Building Systems, or approved equal - submit sample.
- M. Drainage Sand: course, clean, sharp, washed river sand, with no debris.
- N. Metal Edging: Shall be Permaloc 3/16-inch thick x 4-inch high, extruded aluminum, 6063 alloy, T-6 hardness, landscape edging for straight-line and curvilinear applications in corrugated straight profile, as manufactured by Permaloc Corporation, Holland MI 49424, telephone (800) 356-9660 or approved equal. Each section shall have loops on its side to receive stakes spaced approximately 2 to 3 feet apart along its length. Steel edging is not acceptable.

1. For straight runs: Permastrip "L" shape, (Ref #: 006-045)
2. For curved runs: Cleanline, (Ref #: 006-0165)
3. Finish: Black Duraflex
4. Stakes: 12" long, color matched to edging
5. Length: 16'-20' long interlocking pieces

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Obtain written certification from the General Contractor that final grades to within 0.10' have been established prior to commencing planting operations. Provide for inclusion of all amendments, settling, etc. The Contractor shall be responsible for shaping all planting areas as indicated on the drawings, or as directed by the Landscape Architect.
- B. Inspect trees, shrubs, and groundcover plant material for injury, insect infestation, and trees and shrubs for improper pruning.
- C. Do not begin planting of plants until deficiencies are corrected.

#### 3.2 EXCAVATION

- A. In all planting beds, the Contractor shall *thoroughly* remove from the construction site all limestone larger than 3/4" in diameter and all heavy clay to a minimum depth of 18". Use a power rake to remove rocks from sites with more than 1 rock per SY. The LA shall verify that this is complete before the Contractor is authorized to proceed with fill of specified topsoil or grading. Scarify subsoil after removal of rock or heavy clay before adding topsoil to break up any surface tension.
- B. The Contractor shall thoroughly remove from the construction site all the following particles that are larger than 3/4" in diameter: inorganic select fill, heavy clay, limestone, and construction debris, mortar, concrete, paint, paint thinner, chemicals, weeds, plastic, paper, steel, wire, mortar, masonry, construction debris, and other substances that are harmful to plant growth. Remove the above items to these depths: 6" minimum in turf and seed areas, and 18" minimum in planting beds. The LA shall verify that the above items are removed before the Contractor is authorized to proceed with fill with specified topsoil or grading. **DO NOT PLACE ANY FILL ON CONSTRUCTION DEBRIS.**
- C. After clean-up described above and establishment of subgrade, drag entire planting area with teeth of bucket to scarify subsoil to a depth of 4" to break up surface tension and allow water to pass downwards through the soil.
- D. Excavate planting beds so that the rough grade is 8"-9" below top of adjacent pavement or curbs to allow for addition of compost, planting soil, and mulch.
- E. If soils are rocky or full of limestone or heavy clay, install irrigation system before adding topsoil to keep limestone or clay below imported topsoil and the root zone of plants.
- F. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree holes, plant pits, and planting beds.
- G. Excess soil generated from the planting holes and not used as backfill or in the establishment of the final grades, shall be removed to an on-site location, as approved by the Owner. Unacceptable excess soil shall be removed to an appropriate off-site location.
- H. Protect all areas from excessive compaction when trucking plants or other material to the planting site. Existing vegetation identified by the Landscape Architect to remain, shall be protected from trucking operations during construction.

#### 3.3 PRE-PLANT WEED CONTROL

- A. After the irrigation system is operational and approved by the Landscape Architect, apply water for seven (7) to ten (10) calendar days, as needed to achieve weed germination.



- B. If live perennial weeds exist on site at the beginning of the work, spray with a non-selective, systemic contact herbicide, as recommended and applied by an approved, licensed landscape pest control applicator. Leave sprayed plants intact for at least fourteen (14) days to allow systemic kill. Re-apply at 2-week intervals until a complete kill is achieved.
- C. Clear and remove these existing, dead weeds by mowing or grubbing off all plant parts at least 1" below the surface of the soil over the entire area to be planted.
- D. Maintain the site weed-free until final acceptance by the Landscape Architect, utilizing mechanical and chemical treatment.

### 3.4 SOIL PREPARATION

- A. Topsoil: If there is not enough existing approved topsoil on site, apply imported topsoil as specified in PART 2, MATERIALS, to achieve finish grade. If required import topsoil to achieve depth of 24" of approved topsoil in planting beds and tree pits.
- B. Amendments: After finished grades have been established, soil shall be conditioned in the following manner:
  - 1. For stand-alone tree pits: (1) part soil amendment to (2) parts native or imported topsoil.
  - 2. For planting beds:
    - a. After rough grade is established, thoroughly till 2" of Gumbo Buster 2" into existing soil until there is a 4" soil layer that is evenly mixed, loose, and friable.
    - b. Add a full 6" of "Ready-to-Plant" soil mix on top of soil mix.
- C. Fertilization:
  - 1. Trees: Fertilize tree pits at time of planting. Apply specified fertilizer See PART 2, MATERIALS into tree pits at the rate of 1/4 cup per caliper inch to backfill around the root ball. Apply the fertilizer in the presence of the landscape architect. Failure to apply the fertilizer in the presence of the Landscape Architect will result in the Contractor's responsibility to apply a second fertilization, at a time determined by the Landscape Architect, at no additional cost to the Owner. See PART 2, MATERIALS.
  - 2. Shrubs, groundcover, and seasonal color areas: Till fertilizer into the top 6" of the planting bed at the rate of 20 lbs. per 1000 SF. Irrigate immediately following the application. See PART 2, MATERIALS.
- D. Fine Grading: Contractor shall fine grade all areas for approval by LA. Contractor shall be responsible for providing 2% positive drainage in all planting areas. No planting or mulching will take place until all construction, clean-up, fine grading, and irrigation is complete in the immediate area. Final finish grading shall be reviewed by the LA before any planting takes place. Contractor shall be responsible for any additional topsoil required to create a smooth condition prior to planting.
- E. All planting areas shall drain away from buildings by at least 2%.

### 3.5 PLANT INSTALLATION

- A. General:
  - 1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved by the Landscape Architect. Do not plant when raining or into waterlogged or frozen soil.
  - 2. Only as many plants as can be planted, staked, and watered on that same day shall be distributed in a planting area.
  - 3. Containers shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.
- B. Lay-Out of Trees: Locations for Trees and bedlines shall be marked on the ground by the Contractor before any tree pits are dug. All such locations shall be approved by the Landscape Architect.

1. If underground construction or utility lines are encountered in the excavation of planting areas, other locations for planting may be selected by the Landscape Architect. It shall be the Contractor's responsibility to confirm with the Owner, Landscape Architect, and all governing agencies, the location and depth of all underground utilities and obstructions.
  2. Lay-out shall be accomplished with flagged grade stakes indicating tree names and specified plant size on each stake.
- C. Container Removal: Cut the container on the sides with an acceptable can cutter. Do not injure the root ball. After removing the plant from the container, superficially cut the edges of roots with a sharp knife in three (3) equally spaced locations.
- D. Ball & Burlap Removal: Cut off the top 6" of the wire basket. All wire on the root ball with less than a 4" x 4" grid pattern shall be removed entirely and disposed of at an off-site location. Remove all burlap, rope, twine, and wire from around the plant trunk. Lay any burlap back approximately 12", exposing a minimum of the top one-third (1/3) of the root ball. All material or fabric used as a substitution for burlap and is not equal to the degradable qualities of burlap, shall be removed entirely from the root ball and disposed of at an off-site location.
- E. Box Container Removal: Remove the bottom of the plant boxes before planting. Place the plant in the pit, position, and backfill to a minimum of one-third the depth of the root ball. Remove the sides of the boxes without damaging the root ball.
- F. Planting of Trees and Shrubs:
1. Planting pits shall be round and sized in accordance with outlines and dimensions shown on the drawings.
  2. All excavated tree holes shall have sloped sides (see detail) with roughened surfaces and shall be of a size that is two (2x) times the diameter of the root ball for all trees. The depths of all excavated holes shall have a roughened pit bottom and shall be of a depth equal to the depth of the root ball or roots for all trees and shrubs.
  3. If rotating augers or other mechanical diggers are used to excavate holes, the vertical sides of the pits shall be scarified, fractured, or otherwise broken down to eliminate impervious surfaces.
  4. Loosen or scarify the bottom of all plant pits to a depth of 4 inches.
  5. SCARIFY ALL ROOTBALLS (#1 and larger) to prevent plants from remaining pot-bound. This is to be done by hand or with a 3-prong cultivator but never with a shovel or machete.
  6. Center the plant in the pit or trench.
  7. Place shrubs and groundcovers so that the top of the rootball is ¼" to ¾" above finish grade. Trees shall be set 1" above finish grade for each caliper inch of trunk. Example: A 3" tree shall be set 3" above finish grade. DO NOT, UNDER ANY CIRCUMSTANCE, PLANT TREES, SHRUBS OR GROUNDCOVER BELOW FINISH GRADE. DO NOT PLACE ANY SOIL ON TOP OF ROOTBALLS.
  8. Set the plant plumb and hold rigidly in position until the soil has been tamped firmly around the root ball or roots.
  9. After the plant has been placed, backfill shall be added to the hole to cover approximately one-half (1/2) the height of the root ball. At this stage, water shall be added to the top of the partly filled hole to thoroughly saturate the root ball and adjacent soil. WATER IN AND COMPACT PLANTING BACKFILL TO PREVENT FORMATION OF AIR POCKETS.
  10. Backfill the remainder of the hole after the water has percolated and is not standing in the hole. Construct a three-inch (3") water saucer around the edge of the hole. The planting shall be immediately irrigated after planting until the entire area is saturated to the full depth of each hole.
- G. Staking and Guying:
1. Each tree shall be staked into undisturbed soil immediately following planting. Plants shall stand plumb after staking. See detail for staking guidelines. All stakes and guys shall be installed taught, equally spaced, and beyond the root ball. Refer to the detail on drawings.
- H. Pruning:

1. Pruning shall be limited to the minimum necessary to remove injured twigs and branches. All limbs growing in a conflicting, crossing fashion with one another shall be pruned. Pruning may NOT be done prior to the delivery and acceptance of the plant material. PRUNING SHALL BE DONE ONLY IN THE PRESENCE OF THE LANDSCAPE ARCHITECT.
  2. Do not use pruning paint except for Oak Trees. For Oaks, follow best practices by TexasOakWilt.org
    - a. Clean all pruning tools with 10% bleach solution or Lysol between sites and/or trees.
    - b. If possible, avoid pruning Oaks from Feb 1 - June 30.
- I. Planting of Groundcovers and Seasonal Color:
1. Plants shall be grown in pots as indicated on the drawings. Plants shall remain in those pots until the time of transplanting into the designated areas. The pot's soil shall contain enough moisture so that it will not fall apart when lifting the plants from the pot.
  2. Groundcover and seasonal color shall be planted in straight rows, evenly spaced, and at spacing called out on the drawings, unless otherwise noted on the drawings. Triangular spacing shall be used unless otherwise noted on the drawings.
  3. Each rooted plant shall be planted with its proportionate amount of soil. Planting shall be immediately irrigated after planting until the entire area is saturated to the full depth of each hole.
  4. Care shall always be exercised to protect the plants after installation. Any damage to the plants by trampling or other operations of this Contract shall be repaired immediately.
  5. Seasonal color material and placement will be selected by the Landscape Architect at the time of installation.
  6. The Owner and Landscape Architect reserves the right to review and approve all plant material at the nursery or grower.
- J. Mulch Cover:
1. All trees, shrubs, groundcover, and seasonal color areas shall be top-dressed with a (4) four-inch (3" inches after settlement) minimum layer of mulch within 48 hours after planting. Install no more than 1.5" of mulch over the top of the root balls of all plants. See PART 2, MATERIALS.

### 3.6 CLEAN-UP

- A. After all planting operations have been completed, remove all trash, excess soil, empty plant containers, rubbish, and all debris associated with this Contract from the site. All scars, ruts, trench settlement, or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. The Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site, once a week, or the last working day of each week. All trash shall be removed completely from the site.
- B. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition. All walks shall be left in a clean and safe condition.

### 3.7 OBSERVATION SCHEDULE

- A. The Contractor shall be responsible for notifying the Landscape Architect in advance for the following site visits, according to the time indicated:
  1. Pre-job Conference - 7 days
  2. Final grade review - 2 days
  3. Plant material review - 2 days
  4. Plant lay-out review - 2 days
  5. Soil Preparation and planting operations - 2 days
  6. Pre-maintenance - 7 days
  7. Final inspection - 7 days

- B. When observations are conducted by someone other than the Landscape Architect, the Contractor shall show evidence, in writing, of when and by whom these observations were made.
- C. NO site visits shall commence without all items noted in previous Observation Reports either completed or remedied unless such compliance has been waived by the Owner. Failure to accomplish punch list tasks or prepare adequately for desired inspections shall make the Contractor responsible for reimbursing the Landscape Architect at his current billing rates per hour, portal to portal (plus transportation costs) for the inconvenience. NO further inspections shall be scheduled until this charge has been paid and received.

### 3.8 90 DAY MAINTENANCE

- A. The maintenance period shall commence when the Notice of Substantial Completion is issued and shall continue as required for a period of 90 days.
- B. Plants shall be inspected at least once per week by the Contractor during the installation period and needed maintenance performed promptly.
- C. The Contractor shall irrigate all plants adequately to maintain optimum supply of moisture within the root zone; recurring overly dry or wet conditions shall be grounds for rejection of plant material. If the irrigation system is inoperative, hand watering shall be accomplished from a source approved by the Landscape Architect. Water shall not be applied with a force that will displace mulch or cause soil erosion and shall not be applied so quickly that it cannot be absorbed by the mulch and plants.
- D. Plants shall be pruned, and mulch shall be replaced as required.
- E. Tree stakes and guys shall be adjusted or replaced as required. Repair eroded plant saucers.
- F. Always maintain all plant beds and tree saucers weed-free.
- G. Keep plants free of insects and disease. All insecticides and fungicides applied to control pests and maintain plants in a healthy growing condition shall be approved by the Landscape Architect.
- H. Fertilize plants at once during the warranty period. Fertilization shall be applied by topdressing 2 pounds per 100 square feet of bed area, and 3 to 5 pounds each tree. Fertilizer for the application shall be a controlled release type used for the installation.
- I. Remove and replace, at no cost to Owner, dead and unacceptable plants as their condition becomes apparent.

END OF SECTION

**SECTION 33 30 00  
SANITARY SEWERAGE UTILITIES**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Provisions established in the North Central Texas Council of Governments (NCTCOG) Standard Specifications for Public Works Construction, City/County and the Drawings are collectively applicable to this Section.

**1.02 SUMMARY**

- A. Work Included:
  - 1. Installation of pipe material.
  - 2. Construction of manholes.
  - 3. Connection to existing sewer system.
- B. Related Work Specified on Other Sections
  - 1. Section 31 23 33 - TRENCHING AND BACKFILLING
  - 2. Section 33 00 00 - EARTHWORK

**1.03 COORDINATION**

- A. Verify flowline elevation at connection to existing manhole; notify architect if elevation is more than 0.1' above plan elevation.
- B. Coordinate installation with other construction throughout the site.
- C. All construction shall conform to NCTCOG and applicable City/County Standard Specifications for Construction.

**1.04 REFERENCES**

- A. ASTM D3034: Specifications for PVC Sewer Pipe 4" through 15" in diameter.
- B. ASTM D2321: Practice for Installation of Underground Installation

**1.05 SUBMITTALS**

- A. All pipe and fittings not covered by this specification shall be approved by the engineer seven days prior to bid.

**PART 2 - PRODUCTS**

**2.01 PIPE**

- A. Polyvinyl Chloride (PVC) sewer pipe and fittings with dimension control.
  - 1. Pipe shall be SDR-26 or SDR-35 per plans.
  - 2. Pipe Fittings: Pipe fittings shall conform to ASTM D1784. Fittings approved by the Engineer shall also be acceptable.
  - 3. Balance of specifications shall be covered by Item 501.17 per NCTCOG.

**2.02 STRUCTURES**

- A. Materials for the construction of manholes shall be as specified in Division 700, "Concrete Structures" of the NCTCOG's Standard Specifications for Construction.

**PART 3 - EXECUTION**

**3.01 GENERAL**

- A. The locations of all structures and lines and grades of all pipes shall be staked by a registered surveyor. All facilities shall be located according to the site layout plans.
- B. Contractor shall utilize necessary measures including temporary pumping and collection until the public sewer improvements are installed and operational.

**3.02 PIPES**

- A. All pipe shall be inspected prior to installation. Damaged pipes shall not be used. Replacement of damaged pipe shall be made by the Contractor at no expense to the owner.
- B. Installation shall be in accordance with NCTCOG and City/County specifications and as recommended by the

pipe manufacturer. Backfill shall be per plans.

### **3.03 STRUCTURES**

- A. Construction of manholes shall be as specified in Division 700, "Concrete Structures" of NCTCOG and the City's/County's Standard Specifications for Construction.
- B. Connections of pipe to structures shall be completely mortared around the perimeter of the pipe to ensure connection to the structure prior to backfilling. Pipe shall have a rubber boat placed over the end prior to pouring concrete structure or grouting.
- C. All manholes in pavement areas shall be held below pavement and the frame/lid shall be adjusted to final grade with grade rings. There should be no abrupt grade changes at manholes rims. If abrupt grade changes are present, grade adjustments will be required.

**END OF SECTION**

## **SECTION 33 40 00 STORM DRAINAGE UTILITIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

#### **1.2 SUMMARY**

- A. Work Included:
  - 1. Installation of pipe material.
  - 2. Construction of drainage system structures including curb inlets, junction boxes and catch basins.
  - 3. Ditch-out for storm drainage system discharge.
- B. Related Work Specified in Other Sections
  - 1. Section 31 23 33 - TRENCHING AND BACKFILLING
  - 2. Section 31 00 00 - EARTHWORK

#### **1.3 COORDINATION**

- A. Contractor shall coordinate installation of drainage system with other construction throughout the site.
- B. All construction shall conform to applicable City/County Specifications for Construction.
- C. All work of this Section shall be completed within the limits of the site property boundary or designated offsite easements.

#### **1.4 REFERENCES**

- A. ASTM C76: Specification for Reinforced Concrete Pipe
- B. AASHTO M294 HDPE Pipe
- C. ASTM F477 HDPE Fittings

#### **1.5 SUBMITTALS**

- A. All pipe and fittings not covered by this specification shall be approved by the engineer seven days prior to bid.

### **PART 2 - PRODUCTS**

#### **2.1 PIPE**

- A. Reinforced concrete pipe shall be Class III.
- B. Plastic pipe shall be PVC SDR35 or Schedule 40 or HDPE heavy wall meeting the requirements of AASHTO M294 and ASTM F477 with corrugated exterior with smooth lined interior. All pipe joints and fittings shall be watertight.
- C. ADS HP Storm polypropylene pipe (dual wall) meeting the requirements of AASHTO M330, and ASTM F2881 with smooth inner wall and annular exterior corrugations.

#### **2.2 DRAINAGE STRUCTURES**

- A. Materials for the construction of inlets and junction boxes shall be as specified in Division 7, "Structures" of the NCTCOG's Standard Specifications for Construction.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. The locations of all structures and lines and grades of all pipes shall be staked by a registered surveyor. All facilities shall be located according to the site layout plans.
- B. Contractor shall utilize necessary measures, including temporary pumping in order to drain storm water offsite until the public drainage improvements are installed and operational.

#### **3.2 PIPES**

- A. All pipes shall be inspected prior to installation. Damaged pipes shall not be used. Replacement of damaged pipe shall be made by the Contractor at no expense to the owner.

- B. Installation shall be in accordance with ASTM D2321 and as recommended by the pipe manufacturer. Backfill shall be ASTM D2321 Class I, II or III soils.
- C. Pipe installation shall conform to the North Central Texas Council of Governments (NCTCOG) Standard Specifications for Public Works Construction.

### **3.3 DRAINAGE STRUCTURES**

- A. Construction of curb inlets tops and catch basins in pavement areas shall be cast-in-place only with no precast structures allowed. All manholes in pavement areas shall be held below pavement and the frame/lid shall be adjusted to final grade with grade rings. There should be no abrupt grade changes at manholes rims. If abrupt grade changes are present, grade adjustments will be required. Catch basins and headwalls outside of pavement areas shall be either cast-in-place or precast.
- B. Connections of pipe to structures shall be completely mortared around the perimeter of the pipe to ensure watertight connection to the structure prior to backfilling. All bends and tees shall be precast/preformed.
- C. Inlet top and throat shall be poured once pavement improvements are in place.

**END OF SECTION**