

## DOCUMENT 000107B - SEALS PAGE

The documents listed below and included with in this package of contract documents are intended to be represented by the Architect, Julie Wellner, Wellner Architect, Inc, Inc. are limited to:

**Drawings**

|       |                                        |
|-------|----------------------------------------|
| AG001 | ARCHITECTURAL LEGEND AND ABBREVEATIONS |
| AG002 | CODE PLANS                             |
| AG003 | CODE INFORMATION & WALL TYPES          |
| AG004 | GENERAL ACCESSIBILITY                  |
| AG005 | INTERIOR ACCESSIBILITY                 |
| A100  | ARCHITECTURAL SITE DETAILS             |
| A101  | OVERALL FLOOR PLAN                     |
| A102  | FLOOR PLANS                            |
| A111  | OVERALL ROOF PLAN                      |
| A121  | OVERALL REFLECTED CEILING PLANS        |
| A122  | REFLECTED CEILING PLANS                |
| A201  | BUILDING ELEVATIONS                    |
| A301  | BUILDING SECTIONS                      |
| A302  | BUILDING SECTIONS                      |
| A310  | WALL SECTIONS                          |
| A311  | WALL SECTIONS                          |
| A312  | WALL SECTIONS                          |
| A401  | ENLARGED RESTROOM PLANS & ELEVATIONS   |
| A402  | ENLARGED RESTROOM PLANS & ELEVATIONS   |
| A403  | STAIR AND ELEVATOR DETAILS             |
| A501  | DETAILS                                |
| A601  | DOOR/WINDOW SCHEDULES AND DETAILS      |
| A602  | DOOR/WINDOW DETAILS                    |
| A603  | ALUM. STOREFRONT DOOR/WINDOW SCHEDULE  |
| A604  | STOREFRONT DETAILS                     |

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| A610 | FINISH SCHEDULE     |
| A612 | FINISH FLOOR PLANS  |
| A621 | CASEWORK ELEVATIONS |
| A622 | CASEWORK DETAILS    |
| A623 | ADA & CODE SIGNAGE  |

**Specifications**

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| 05 73 00    | Decorative Metal Railings                    |
| 06 10 00    | Rough Carpentry                              |
| 06 16 00    | Sheathing                                    |
| 06 41 16    | Plastic-Laminate-Clad Architectural Cabinets |
| 07 21 00    | Thermal Insulation                           |
| 07 25 00    | Weather Barriers                             |
| 07 27 26    | Fluid-Applied Membrane Air Barriers          |
| 07 42 13.13 | Formed Metal Wall Panels                     |
| 07 42 93    | Soffit Panels                                |
| 07 54 23    | Thermoplastic-Polyolefin (TPO) Roofing       |
| 07 62 00    | Sheet Metal Flashing and Trim                |
| 07 72 53    | Snow Guards                                  |
| 07 84 43    | Joint Firestopping                           |
| 07 92 00    | Joint Sealants                               |
| 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 16    | Hangar doors                                 |
| 08 36 13    | Sectional Doors                              |
| 08 41 13    | Aluminum-Framed Entrances and Storefronts    |
| 08 42 29.23 | - Sliding Automatic Entrances                |

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| 08 45 23    | Fiberglass-Sandwich-Panel Assemblies                      |
| 08 71 00    | Door Hardware                                             |
| 08 80 00    | Glazing                                                   |
| 08 83 00    | Mirrors                                                   |
| 08 88 13    | Fire-Rated Glazing                                        |
| 08 88 53    | Security Glazing                                          |
| 09 22 16    | Non-Structural Metal Framing                              |
| 09 29 00    | Gypsum Board                                              |
| 09 30 13    | Ceramic Tiling                                            |
| 09 51 13    | Acoustical Panel Ceilings                                 |
| 09 54 26    | Suspended Wood Ceilings                                   |
| 09 65 13    | Resilient Base and Accessories                            |
| 09 67 23    | Resinous Flooring                                         |
| 09 91 14    | Exterior Painting (MPI Standards)                         |
| 09 91 24    | Interior Painting (MPI Standards)                         |
| 10 14 19    | Dimensional Letter Signage                                |
| 101423.16   | Room-Identification Panel Signage                         |
| 10 21 13.17 | Phenolic-Core Toilet Compartments                         |
| 10 21 13.17 | Phenolic-Core Toilet Compartments                         |
| 10 28 00    | Toilet, Bath, And Laundry Accessories                     |
| 10 44 13    | Fire Protection Cabinets                                  |
| 10 44 16    | Fire Extinguishers                                        |
| 11 30 13    | Residential Appliances                                    |
| 11 52 13    | Projection Screens                                        |
| 12 36 23.13 | Plastic-Laminate-Clad Countertops                         |
| 12 36 61.16 | Solid Surfacing Countertops                               |
| 133419      | Metal Building Systems                                    |
| 14 21 23.16 | - Machine Room-Less Electric Traction Passenger Elevators |

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The documents listed below and included with in this package of contract documents are intended to be represented by the Engineer, Cory Wilson, Olsson, Inc. are limited to:

**Drawings**

|       |                                           |
|-------|-------------------------------------------|
| E001  | GENERAL ELECTRICAL INFORMATION            |
| E002  | SITE LIGHTING PHOTOMETRICS PLAN           |
| E003  | ELECTRICAL SITE PLAN                      |
| E101  | LIGHTING FLOOR PLANS                      |
| E102  | LIGHTING HANGAR FLOOR PLAN                |
| E201  | POWER FLOOR PLANS                         |
| E202  | POWER HANGAR PLAN                         |
| E301  | SYSTEMS FLOOR PLANS                       |
| E302  | SYSTEMS HANGAR PLAN                       |
| E401  | ENLARGED PLANS                            |
| E501  | DIAGRAMS                                  |
| E601  | ELECTRICAL DETAILS                        |
| E602  | ELECTRICAL DETAILS                        |
| E701  | ELECTRICAL SCHEDULES                      |
| E702  | ELECTRICAL SCHEDULES                      |
| E703  | ELECTRICAL SCHEDULES                      |
| FP001 | FIRE PROTECTION GENERAL NOTES AND DETAILS |
| FP101 | FIRE PROTECTION FLOOR PLANS               |
| FP102 | FIRE PROTECTION HANGAR FLOOR PLAN         |
| M001  | GENERAL MECHANICAL INFORMATION            |
| M101  | MECHANICAL FLOOR PLANS                    |
| M102  | MECHANICAL HANGAR FLOOR PLAN              |
| M401  | ENLARGED PLANS                            |
| M501  | P&ID'S                                    |
| M601  | MECHANICAL DETAILS                        |

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| M701 | MECHANICAL SCHEDULES                                  |
| P001 | GENERAL PLUMBING INFORMATION                          |
| P101 | DOMESTIC WATER & NATURAL GAS PIPING FLOOR PLANS       |
| P102 | DOMESTIC WATER & NATURAL GAS PIPING HANGAR FLOOR PLAN |
| P201 | SANITARY PIPING FLOOR PLANS                           |
| P202 | SANITARY PIPING HANGAR FLOOR PLAN                     |
| P401 | ENLARGED PLANS                                        |
| P501 | DIAGRAMS, RISERS                                      |
| P601 | PLUMBING DETAILS                                      |
| P701 | PLUMBING SCHEDULES                                    |

**Specifications**

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| 210010    | BASIC MECHANICAL REQUIREMENTS FOR SUPPRESSION                  |
| 210500    | COMMON WORK RESULTS FOR FIRE SUPPRESSION                       |
| 210523    | GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING    |
| 210529    | HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT |
| 210553    | IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT       |
| 210800    | COMMISSIONING OF FIRE SUPPRESSION                              |
| 211000    | WATER-BASED FIRE-SUPPRESSION SYSTEMS                           |
| 220010    | BASIC MECHANICAL REQUIREMENTS FOR PLUMBING                     |
| 220500    | COMMON WORK RESULTS FOR PLUMBING                               |
| 220523.12 | BALL VALVES FOR PLUMBING PIPING                                |
| 220529    | HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT         |
| 220716    | PLUMBING EQUIPMENT INSULATION                                  |
| 220719    | PLUMBING PIPING INSULATION                                     |
| 221116    | DOMESTIC WATER PIPING                                          |
| 221119    | DOMESTIC WATER PIPING SPECIALTIES                              |
| 221316    | SANITARY WASTE AND VENT PIPING                                 |
| 221319    | SANITARY WASTE PIPING SPECIALTIES                              |

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| 224213.13   | COMMERCIAL WATER CLOSETS                                     |
| 224213.16   | COMMERCIAL URINALS                                           |
| 224216.13   | COMMERCIAL LAVATORIES                                        |
| 224216.16   | COMMERCIAL SINKS                                             |
| 224713      | DRINKING FOUNTAINS                                           |
| 230010      | BASIC MECHANICAL REQUIREMENTS FOR HVAC                       |
| 230500      | COMMON WORK RESULTS FOR HVAC                                 |
| 230529      | HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT           |
| 230553      | IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT                 |
| 230593      | TESTING, ADJUSTING, AND BALANCING FOR HVAC                   |
| 230713      | DUCT INSULATION                                              |
| 230716      | HVAC EQUIPMENT INSULATION                                    |
| 230719      | HVAC PIPING INSULATION                                       |
| 231123      | FACILITY NATURAL-GAS PIPING                                  |
| 233113      | METAL DUCTS                                                  |
| 233300      | AIR DUCT ACCESSORIES                                         |
| 233346      | FLEXIBLE DUCTS                                               |
| 233423      | HVAC POWER VENTILATORS                                       |
| 233713.13   | AIR DIFFUSERS                                                |
| 233713.23   | AIR REGISTERS AND GRILLES                                    |
| 238239.19   | WALL AND CEILING UNIT HEATERS                                |
| 26 01 00    | BASIC ELECTRICAL REQUIREMENTS                                |
| 26 01 50    | BASIC ELECTRICAL MATERIALS AND METHODS                       |
| 26 05 19    | LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES           |
| 26 05 26    | GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS                 |
| 26 05 33    | RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS                    |
| 26 05 44    | SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING |
| 26 05 73.16 | COORDINATION STUDIES                                         |
| 26 09 23    | LIGHTING CONTROL DEVICES                                     |
| 26 22 13    | LOW-VOLTAGE DISTRIBUTION TRANSFORMERS                        |

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26 24 16 PANELBOARDS  
26 27 26 WIRING DEVICES  
26 28 13 FUSES  
26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS  
26 43 13 SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS  
26 51 19 LED INTERIOR LIGHTING  
26 56 13 LIGHTING POLES AND STANDARDS  
26 56 19 LED EXTERIOR LIGHTING  
27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS  
28 46 21.11 ADDRESSABLE FIRE-ALARM SYSTEMS



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**Drawings**

|      |                               |
|------|-------------------------------|
| S000 | STRUCTURAL GENERAL NOTES      |
| S001 | STRUCTURAL GENERAL NOTES      |
| S002 | SPECIAL INSPECTIONS           |
| S100 | FOUNDATION PLAN - OVERALL     |
| S101 | FOUNDATION PARTIAL PLANS      |
| S102 | MEZZANINE FRAMING PLAN        |
| S200 | TYPICAL FOUNDATION DETAILS    |
| S201 | FOUNDATION DETAILS            |
| S202 | FOUNDATION DETAILS            |
| S300 | TYPICAL STEEL FRAMING DETAILS |
| S301 | STEEL FRAMING DETAILS         |
| S400 | TYPICAL CMU FRAMING DETAILS   |

**Specifications**

|        |                                  |
|--------|----------------------------------|
| 031000 | Concrete Forming and Accessories |
| 032000 | Concrete Reinforcing             |
| 033000 | Cast-In-Place Concrete           |
| 042000 | Unit Masonry                     |
| 051200 | Structural Steel Framing         |
| 053100 | Steel Decking                    |
| 054000 | Cold-Formed Metal Framing        |
| 055000 | Metal Fabrications               |
| 055113 | Metal Pan Stairs                 |

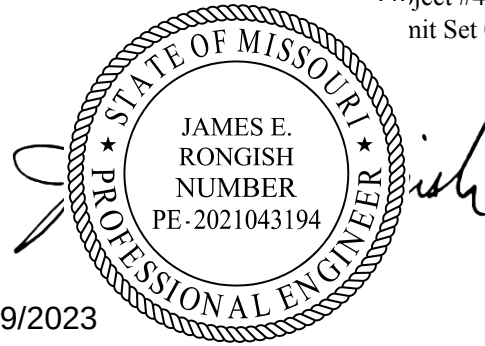
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**SECTION 031000 - CONCRETE FORMING AND ACCESSORIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Form-facing material for cast-in-place concrete.
  - 2. Shoring, bracing, and anchoring.

**1.3 DEFINITIONS**

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Exposed surface form-facing material.
  - 2. Concealed surface form-facing material.
  - 3. Pan-type forms.
  - 4. Void forms.
  - 5. Form ties.
  - 6. Waterstops.
  - 7. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
  - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
  - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

- a. Location of construction joints is subject to approval of the Architect.
- 3. Indicate location of waterstops.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Field quality-control reports.
- C. Minutes of preinstallation conference.

#### 1.6 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
  - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
  - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

1)

#### 2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:



1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
  - a. Plywood, metal, or other approved panel materials.
  - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

- 1) APA HDO (high-density overlay).
- 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
- 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
- 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight or tapered end forms.

- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

## 2.3 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.
- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

## 2.4 RELATED MATERIALS

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
  2. Form release agent for form liners shall be acceptable to form liner manufacturer.

- C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
  - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
  - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes .
- C. Limit concrete surface irregularities as follows:
  - 1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
  2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  3. Place joints perpendicular to main reinforcement.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.2 INSTALLATION OF 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.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Clean embedded items immediately prior to concrete placement.

### 3.3 INSTALLATION OF WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
  1. Install in longest lengths practicable.
  2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  3. Protect exposed waterstops during progress of the Work.

### 3.4 REMOVING AND REUSING FORMS

- A. 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 for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support 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.
  1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  1. Align and secure joints to avoid offsets.
  2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

END OF SECTION

**SECTION 032000 - CONCRETE REINFORCING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

**1.2 ACTION SUBMITTALS****A. Product Data: For the following:**

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

**B. Shop Drawings: Comply with ACI SP-066:**

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

**C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.**

1. Location of construction joints is subject to approval of Engineer.

**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Statements: For testing and inspection agency.****B. Welding certificates.**

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

**C. Material Test Reports: For the following, from a qualified testing agency:**

1. Steel Reinforcement:

- a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- 2. Mechanical splice couplers.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 , deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

#### 2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut 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.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

- a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; mechanical-lap type.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  - 1. Finish: Plain.

## 2.3 FABRICATING REINFORCEMENT

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

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. 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 reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.



1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
  - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
1. Place joints perpendicular to main reinforcement.
  2. Continue reinforcement across construction joints unless otherwise indicated.
  3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. 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.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION

**SECTION 033000 - CAST-IN-PLACE CONCRETE****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Concrete standards.
2. Concrete materials.
3. Admixtures.
4. Vapor retarders.
5. Floor and slab treatments.
6. Liquid floor treatments.
7. Curing materials.
8. Accessories.
9. Repair materials.
10. Concrete mixture materials.
11. Concrete mixture class types.
12. Concrete mixing.

**B. Related Requirements:**

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

**1.2 DEFINITIONS****A. Cementitious Materials:** Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

**B. Water/Cementitious Materials (w/cm) Ratio:** The ratio by weight of mixing water to cementitious materials.**1.3 ACTION SUBMITTALS****A. Product Data:**

1. Portland cement.
2. Blended hydraulic cement.

3. Fly ash.
4. Slag cement.
5. Silica fume.
6. Aggregates.
7. Admixtures:
  - a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.
8. Vapor retarders.
9. Floor and slab treatments.
10. Liquid floor treatments.
11. Curing materials.
12. Joint fillers.
13. Repair materials.

**B. Design Mixtures:** For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Durability exposure classes for Exposure Categories F, S, W, and C.
4. Maximum w/cm ratio.
5. Slump or slump flow limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Intended placement method.
9. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

**C. Shop Drawings:**

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - a. Location of construction joints is subject to approval of the Architect.

**D. Concrete Schedule:** For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:

1. Concrete class designation.
2. Location within Project.
3. Exposure class designation.
4. Formed surface finish designation and final finish.
5. Final finish for floors.
6. Floor treatment, if any.

## **1.4 INFORMATIONAL SUBMITTALS**

**A. Qualification Data:** For the following:

1. Installer: Include copies of applicable ACI certificates.
  - B. Material Certificates: For each of the following:
    1. Cementitious materials.
    2. Admixtures.
    3. Curing compounds.
    4. Floor and slab treatments.
    5. Bonding agents.
    6. Adhesives.
    7. Vapor retarders.
    8. Semirigid joint filler.
    9. Joint-filler strips.
    10. Repair materials.
  - C. Material Test Reports: For the following:
    1. Portland cement.
    2. Blended hydraulic cement.
    3. Fly ash.
    4. Slag cement.
    5. Silica fume.
    6. Aggregates.
    7. Admixtures.
  - D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances in accordance with ACI 117 and in compliance with ASTM E1155.
  - E. Minutes of preinstallation conference.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.
    1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
  - B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
    1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with ASTM C94/C94M and ACI 301.

**1.7 FIELD CONDITIONS**

- A. Cold-Weather Placement: Comply with ACI 301 as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.

- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed .
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

**PART 2 - PRODUCTS****2.1 CONCRETE STANDARDS**

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

**2.2 CONCRETE MATERIALS**

- A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type of admixture from single source from single manufacturer.

- B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, [gray] [white].
2. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, portland-limestone cement.
3. Pozzolans: ASTM C618, Class C, F, or N.
4. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

5. Silica Fume: ASTM C1240.

C. Normal-Weight Aggregates:

1. Coarse Aggregate: ASTM C33/C33M, Class 3S
2. Maximum Coarse-Aggregate Size: 1 inch nominal.
3. Fine Aggregate: ASTM C33/C33M.
4. Alkali-Silica Reaction: Comply with one of the following for each aggregate used:
  - a. Expansion Result of Aggregate: Not more than 0.04 percent at one year when tested in accordance with ASTM C1293.
  - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567. Do not use this option with fly ash with an alkali content greater than 4.0 percent. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent when tested in accordance with ASTM C1260.
  - c. Alkali Content in Concrete: Not to exceed 4 lb./cu. yd. for aggregate with expansion greater than or equal to 0.04 percent and less than 0.12 percent or 3 lb./cu. yd. for aggregate with expansion greater than or equal to 0.12 percent and less than 0.24 percent. Test aggregate reactivity in accordance with ASTM C1293. Calculate alkali content of concrete in accordance with ACI 301. Do not use this option with natural pozzolan or fly ash that has a calcium oxide content greater than 18 percent or an alkali content greater than 4.0 percent; or for an aggregate with expansion at one year greater than or equal to 0.24 percent when tested in accordance with ASTM C1293.

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C260/C260M.
- B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  2. Retarding Admixture: ASTM C494/C494M, Type B.
  3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
- C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

**2.5 LIQUID FLOOR TREATMENTS**

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

**2.6 CURING MATERIALS**

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
    - b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
    - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Water: Potable water that does not cause staining of the surface.
- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

**2.7 ACCESSORIES**

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

**2.8 REPAIR MATERIALS**

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

**2.9 CONCRETE MIXTURE MATERIALS**

- 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, in accordance with ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
  2. Slag Cement: 50 percent by mass.
  3. Silica Fume: 10 percent by mass.
  4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.



5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

## 2.10 CONCRETE MIXTURE CLASS TYPES

- A. Class A: Normal-weight concrete used for footings, grade beams, tie beams, and foundation walls.

1. Exposure Class: ACI 318 Class F2 Class W1 Class C1.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm Ratio: 0.45.
4. Air Content:
  - a. Exposure Classes F2 and F3: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cementitious materials.

- B. Class B: Normal-weight concrete used for interior slabs-on-grade and topping slabs.

1. Exposure Class: ACI 318 Class F0 Class C0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm Ratio : 0.45.
4. Air Content:
  - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

## 2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
  1. Daily access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
  4. Security and protection for test samples and for testing and inspection equipment at Project site.

### 3.3 TOLERANCES

- A. Comply with ACI 117.

### 3.4 INSTALLATION OF 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.
  1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### 3.5 INSTALLATION OF VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  2. Face laps away from exposed direction of concrete pour.
  3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  7. Protect vapor retarder during placement of reinforcement and concrete.

- a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides and sealing to vapor retarder.

### 3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
  1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
  1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. 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.
- D. 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. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  - 2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: 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. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  - 2. 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:
  - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
  - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

### 3.8 APPLICATION OF FINISHING FLOORS AND SLABS

1.

- B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
6. 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.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
  - a. Slabs on Ground:
    - 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.
  - b. Suspended Slabs:
    - 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

### 3.9 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

- a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117, Class D.
  - e. Apply to concrete surfaces for metal lap pan deck formed surfaces and those surfaces that are buried or covered with subsequent installed surfaces.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. ACI 301 Surface Finish SF-3.0:
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/8 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class A.
  - e. Locations: Apply to concrete surfaces exposed to public view,.
  - f.

### 3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling in:
  1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
  3. 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 troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  3. Minimum Compressive Strength: 4500 psi at 28 days.
  4. 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.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete, place and secure anchorage devices.

- a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - b. Cast anchor-bolt insert into bases.
  - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  1. Cast-in inserts and accessories, as shown on Drawings.
  2. Screed, tamp, and trowel finish concrete surfaces.

### 3.11 APPLICATION OF CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
  1. Comply with ACI 301 for cold weather protection during curing.
  2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
  3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
  1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  3. If forms remain during curing period, moist cure after loosening forms.
  4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
    - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
      - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
      - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
  1. Begin curing after finishing concrete.

**2. Interior Concrete Floors:**

- a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) 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, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:
    - a) Water.
    - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) 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, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.



- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
  - a) Water.
  - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- d. Floors To Receive Urethane Flooring:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
  - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
  - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
  - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
  - 5)

### 3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.
  1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than 28 days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
  4. Rinse with water; remove excess material until surface is dry.

5. Apply a second coat in a similar manner if surface has received a float finish or abrasive surface preparation.

- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

### 3.13 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one month.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

### 3.14 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
  1. Repair and patch defective areas when approved by Architect.
  2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, 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 in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    - d. Fill and compact with patching mortar before bonding agent has dried.
    - e. 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 matches surrounding color.
  - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
  - b. Compact mortar in place and match surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.

**D. Repairing Unformed Surfaces:**

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
  - a. Correct low and high areas.
  - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.
  - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
  - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
  - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
  - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
  - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.

- b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
  - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
  - d. Place, compact, and finish to blend with adjacent finished concrete.
  - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
  - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
  - b. Dampen cleaned concrete surfaces and apply bonding agent.
  - c. Place patching mortar before bonding agent has dried.
  - d. Compact patching mortar and finish to match adjacent concrete.
  - e. 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.

### 3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  - 1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
  - 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.

- 7) Location in Work of concrete represented by samples.
  - 8) Date and time sample was obtained.
  - 9) Truck and batch ticket numbers.
  - 10) Design compressive strength at 28 days.
  - 11) Concrete mixture designation, proportions, and materials.
  - 12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
  - 13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.
  - 14) Type of fracture and compressive break strengths at seven days and 28 days.
4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.
- C. Delivery Tickets: comply with ASTM C94/C94M.
- D. Inspections:
1. Headed bolts and studs.
  2. Verification of use of required design mixture.
  3. Concrete placement, including conveying and depositing.
  4. Curing procedures and maintenance of curing temperature.
  5. Verification of concrete strength before removal of shores and forms from beams and slabs.
  6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
  3. Slump Flow: ASTM C1611/C1611M:
    - a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests as needed.
  4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; .
  5. Concrete Temperature: ASTM C1064/C1064M:

- a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.
6. Concrete Density: ASTM C138/C138M:
  - a. One test for each composite sample when strength test specimens are cast.
7. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.3.
8. Compression Test Specimens: ASTM C31/C31M:
  - a. Cast and standard cure two sets of two 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.
9. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 [other age] days.
  - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
10. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
12. 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.
13. Additional Tests:
  - a. Testing and inspecting agency to 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.
  - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.

14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### 3.16 PROTECTION

#### A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION

**SECTION 042000 - UNIT MASONRY****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Concrete masonry units.
2. Lintels.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Accessories.
7. Mortar and grout mixes.

**B. Related Requirements:**

1. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

**1.2 DEFINITIONS****A. CMU(s): Concrete masonry unit(s).****B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.****1.3 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. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.

**C. Samples for Verification: For each type and color of the following:**

1. Exposed CMUs.
2. Pre-faced CMUs.
3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.



**1.4 INFORMATIONAL SUBMITTALS****A. Material Certificates:** For each type of the following:

1. Masonry units.
  - a. Include data on material properties.
  - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

**B. Qualification Statements:** For testing agency.**C. 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.

**D. Statement of Compressive Strength of Masonry:** For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.**E. Cold-Weather and Hot-Weather Procedures:** Detailed description of methods, materials, and equipment to be used to comply with requirements.**1.5 QUALITY ASSURANCE****A. Qualifications:**

1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
2. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

**1.6 MOCKUPS**

- A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
- B. 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]. [ See Section 014339 "Mockups" for additional construction requirements for integrated exterior mockups.]
  - 1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 16 inches long in each mockup.
  - 2. Clean 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.

**1.7 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.

**1.8 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 down both sides of walls, and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches 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 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 from single manufacturer.

- 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 and will be within 20 ft. vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1.

## 2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent where indicated.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested in accordance with ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, will show no visible water or leaks on the back of test specimen.

- a. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1) Echelon Trenwyth.

- b. .

C. CMUs: ASTM C90, normal weight.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2350 psi.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

D. Decorative CMUs: ASTM C90, normal weight.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Echelon.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2350 psi.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
4. Pattern and Texture: Scored vertically to appear square in stacked bond, standard finish. Match Architect's samples.
5. Colors: Match Architect's samples.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

## 2.5 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.

## 2.6 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 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.
- E. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C404.
- G. 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.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- I. Water: Potable.

## 2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- 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 steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Mill- galvanized carbon steel.

2. Exterior Walls: Hot-dip galvanized carbon steel.
  3. Wire Size for Side Rods: 0.148-inch diameter.
  4. Wire Size for Cross Rods: 0.148-inch diameter.
  5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  6. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

## 2.8 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).

## 2.9 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 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.
1. For masonry below grade or in contact with earth, use Type S.
  2. For reinforced masonry, use Type N.
  3. For mortar parge coats, use Type S or Type N.
  4. 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.
  5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

- D. Pigmented Mortar: Use colored cement product.
- 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].
  - 3. Provide grout with a slump of 8 to 11 inches 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.

### 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 or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch 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., or 1/2-inch 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., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch 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., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch 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, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch 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 running bond ; do not use units with less-than-nominal 4-inch 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 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch 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. 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.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- 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. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
  - 3. 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.
  - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  3. Bed webs in mortar in grouted masonry, including starting course on footings.
  4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
  5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. 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.
- 1.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
- 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.

### 3.7 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 control joints in concrete masonry as follows:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

- 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 079200 "Joint Sealants," but not less than 3/8 inch.

### 3.8 LINTELS

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

### 3.9 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.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. 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. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- F. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for [mortar air content] [and] [compressive strength].
- G. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- H. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 28 days.
- 3.11 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 nonmasonry 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 concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

### 3.12 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.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  1. Crush masonry waste to less than 4 inches in each dimension.
  2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
  3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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**SECTION 051200 - STRUCTURAL STEEL FRAMING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Structural-steel materials.
2. Shrinkage-resistant grout.

**B. Related Requirements:**

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for painting requirements.
4. Section 133419 "Metal Building Systems" for structural steel.

**1.2 DEFINITIONS**

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

**1.3 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 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.

**1.4 PREINSTALLATION MEETINGS**

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

**1.5 ACTION SUBMITTALS**

- A. Product Data:



1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Shop primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

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. Identify members not to be shop primed.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. 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.
- F. Survey of existing conditions.
- G. Source quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.

- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

## 1.8 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.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- a.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A572/A572M, Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

**2.3 BOLTS AND CONNECTORS**

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Plain.
- C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

**2.4 RODS**

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.
  - 1. Configuration: Straight.
  - 2. Nuts: ASTM A563 heavy-hex carbon steel.
  - 3. Plate Washers: ASTM A36/A36M carbon steel.
  - 4. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 5. Finish: Plain.
  - 6.
- B. Threaded Rods: ASTM A36/A36M.
  - 1. Nuts: ASTM A63 heavy-hex carbon steel.
  - 2. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 3. Finish: Plain.

**2.5 PRIMER**

- A. Steel Primer:
  - 1. Comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

**2.6 SHRINKAGE-RESISTANT GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

**2.7 FABRICATION**

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Fabricate beams with rolling camber up.
  - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing 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 in accordance with SSPC-SP 2.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with 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 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, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

**2.8 SHOP CONNECTIONS**

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength 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. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

**2.9 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.
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces .
  - 6. Corrosion-resisting (weathering) steel surfaces.
  - 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  - 1. SSPC-SP 2.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

**2.10 SOURCE QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
  - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  - 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  - a. Liquid Penetrant Inspection: ASTM E165/E165M.
  - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  - c. Ultrasonic Inspection: ASTM E164.
  - d. Radiographic Inspection: ASTM E94/E94M.
4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
  - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
5. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify, with certified 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 existing conditions. Include 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 on Drawings.

#### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

- B. Baseplates, Bearing Plates, 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 shrinkage-resistant 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 grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- 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 are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
  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.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: Snug tightened, unless otherwise noted on drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M[ and AWS D1.8/D1.8M] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with ANSI/AISC 303 and ANSI/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, back gouge, and grind steel smooth.
  3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.5 REPAIR

- A. Touchup Painting:
  - 1. 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.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  - 2. Cleaning and touchup painting are specified in Section 099123 "Interior Painting." and Section 099600 "High-Performance Coatings."
- B. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

### 3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  - 1. Bolted Connections: Inspect[ and test] bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
      - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3) Ultrasonic Inspection: ASTM E164.
      - 4) Radiographic Inspection: ASTM E94/E94M.



3. Shear Stud Connectors: 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:
  - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

END OF SECTION

**SECTION 053100 - STEEL DECKING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Composite floor deck.

**B. Related Requirements:**

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Composite floor deck.

**B. Shop Drawings:**

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

**1.3 INFORMATIONAL SUBMITTALS****A. Welding certificates.****B. Product Certificates:** For each type of steel deck.**C. Test and Evaluation Reports:**

1. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

**D. Field Quality-Control Submittals:**

1. Field quality-control reports.

**1.4 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
  - 1. AWS D1.3/D1.3M.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. 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 PERFORMANCE REQUIREMENTS**

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. 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 listings of another qualified testing agency.

**2.2 COMPOSITE FLOOR DECK**

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
  - 1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 40 minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard baked-on, rust-inhibitive primer.
  - 2. Profile Depth: As indicated.
  - 3. Design Uncoated-Steel Thickness: As indicated.
  - 4. Span Condition: Triple span or more.

## 2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- D. 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.
- E. 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 indicated.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- H. 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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; 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. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.3 INSTALLATION OF FLOOR DECK

- 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:
    - a. 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. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-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.
- 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 or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.4 REPAIR

#### A. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 09 96 00 "High-Performance Coatings" and Section 099123 "Interior Painting."

### 3.5 FIELD QUALITY CONTROL

#### A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

#### B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
  - a. Field welds will be subject to inspection.
2. Steel decking will be considered defective if it does not pass tests and inspections.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
  - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.

#### C. Prepare test and inspection reports.

END OF SECTION 053100

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**SECTION 054000 - 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. Ceiling joist framing.
4. Soffit framing.

**B. Related Requirements:**

1. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

**1.2 ACTION SUBMITTALS****A. Product Data: For the following:**

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Floor joist framing.
10. Roof-rafter framing.
11. Ceiling joist framing.
12. Soffit framing.
13. Post-installed anchors.
14. Power-actuated anchors.
15. Sill sealer gasket.
16. Sill sealer gasket/termite barrier.

**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.



- C. Delegated Design Submittal: For cold-formed steel framing.

### 1.3 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 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.

### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association , the Steel Framing Industry Association , the Steel Stud Manufacturers Association , or the Supreme Steel Framing System Association.
- D. 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."

## 1.5 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 PERFORMANCE REQUIREMENTS

- A. 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**] <Insert design loads>.
  2. Deflection Limits: Design framing systems to withstand[ **design loads**] without deflections greater than the following:
    - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
    - b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft..
    - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
  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.
  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.
  5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.
- C. 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.

**2.2 COLD-FORMED STEEL FRAMING MATERIALS**

- A. Framing Members, General: Comply with AISI S240 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, A60, AZ50, or GF30.
- 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.

**2.3 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: 0.0428 inch.
  - 2. Flange Width: 1-5/8 inches.
- 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: 0.0428 inch.
  - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips, Exterior: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch .
  - 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0428 inch .
    - b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
  2. Inner Track: Of web depth indicated, and as follows:
    - a. Minimum Base-Metal Thickness: 0.0428 inch.
- F. 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.
- 2.4 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: 0.0329 inch.
  2. Flange Width: 1-3/8 inches.
- 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: 0.0329 inch.
  2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips, Interior: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch .
  2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
- 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.

**2.5 CEILING JOIST FRAMING**

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
  2. Flange Width: 1-5/8 inches, minimum.

**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: 0.0428 inch.
  2. Flange Width: 1-5/8 inches, minimum.

**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. 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, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
  - 1. Uses: Securing cold-formed steel framing to structure.
  - 2. Type: Torque-controlled expansion anchor or adhesive anchor.
  - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- C. 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.
- D. 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.
- E. Welding Electrodes: Comply with AWS standards.

## 2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- D. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch 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 and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch 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.

### 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. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.
- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

- D. 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.
- 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 072100 "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. Install single deep-leg deflection tracks and anchor to building structure.
  - 2. Connect vertical deflection clips to studs 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 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.
  - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. 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. Install single deep-leg deflection tracks and anchor to building structure.
  2. Connect vertical deflection clips to studs 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 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.
  3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
  1. Install solid blocking at centers indicated on Shop Drawings.
- G. 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 OF JOIST FRAMING

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
  2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as required.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
  1. Joist Spacing: As indicated on Drawings.

- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
  - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.7 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 and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.8 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.

### 3.9 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.

### 3.10 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 054000

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**SECTION 055000 - METAL FABRICATIONS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Miscellaneous framing and supports.
2. Metal ladders.
3. Elevator pit sump covers.
4. Metal bollards.

**B. Products furnished, but not installed, under this Section include the following:**

1. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

**C. Related Requirements:**

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.

**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:**

1. Fasteners.
2. Shop primers.

3. Shrinkage-resisting grout.
4. Slotted channel framing.
5. Manufactured metal ladders.
6. Metal bollards.

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 the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Elevator machine beams, hoist beams, and divider beams.
3. Steel shapes for supporting elevator door sills.
4. Metal ladders.
5. Elevator pit sump covers.
6. Metal bollards.

C. Delegated Design Submittals: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. 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."
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless 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 014000 "Quality Requirements," to design ladders.
  - 1.
- B. 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 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. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
- D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
- E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A53/A53M, Standard Weight unless otherwise indicated.
- G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
  - 2. Galvanized Steel: ASTM A653/A653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.
  - 3. Cold-Rolled Steel: ASTM A1008/A1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
- H. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- I. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.



**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 aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. 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.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or adhesive 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 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

**2.4 MISCELLANEOUS MATERIALS**

- A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer that contains pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. 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.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 4000 psi.

## 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 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.
- 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, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches 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. Fabricate units from slotted channel framing where indicated.
  2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

## 2.7 METAL LADDERS

- A. General:

1. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 16 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- 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.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
8. Prime ladders, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.8 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1 inch in least dimension.
- B. Provide steel angle supports unless otherwise indicated.

2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
  1. Cap bollards with 1/4-inch- thick, steel plate.
  2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
  3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8-inch- thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
  1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe or tubing with 1/4-inch- thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Prime steel bollards with primer specified in Section 099600 "High-Performance Coatings."

**2.10 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 primer specified in Section 099600 "High-Performance Coatings."

**2.11 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.

**2.12 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.

**2.13 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 primers specified in Section 099600 "High-Performance Coatings" are indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- 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.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

### 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 supports for ceiling-hung toilet partitions, operable partitions, overhead doors, and overhead grilles securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
  1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

### 3.3 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.

### 3.4 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.

### 3.5 INSTALLATION OF METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
  1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction with anchor bolts. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
  1. Embed anchor bolts at least 6 inches in concrete.

- C. Anchor bollards in concrete in formed or core-drilled holes not less than 36 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- D. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- E. Anchor internal sleeves for removable bollards in formed or core-drilled holes not less than 36 inches deep and 3/4 inch larger than OD of sleeve. Fill annular space around internal sleeves solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.
- F. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- G. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- H. Fill bollards solidly with concrete, mounding top surface to shed water.
  - 1. Do not fill removable bollards with concrete.

### 3.6 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.

### 3.7 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 dry film thickness.
  - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 96 00 "High Performance Coatings."



- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

**SECTION 055113 - METAL PAN STAIRS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings and guards attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

**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, railings, and guards.**

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, 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. Perforated metal.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Prefilled metal-pan-stair treads.
5. Abrasive nosings.
6. Shop primer products.

7. Nonslip-aggregate concrete finish.
8. Abrasive-coating finish to formed-metal stairs.
9. Handrail wall brackets.
10. Grout.

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 locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Samples for Verification: For each type and finish of nosing.

D. Delegated Design Submittal: For stairs, railings and guards, , 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 State 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 014000 "Quality Requirements," to design stairs, railings and guards, , including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs 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..
  2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  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, whichever is less.
- C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, 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. applied in any direction.
    - b. Concentrated load of 200 lbf 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 applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
    - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Seismic Performance of Stairs:As indicated on drawings.

**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. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed).
- D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight, unless another grade and weight are required by structural loads.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, structural steel, Grade 25, unless another grade is required by design loads; exposed.
- F. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30, unless another grade is required by design loads.
- G. Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, structural steel, Grade 33, unless another grade is required by design loads.
- H. Expanded-Metal, Carbon Steel: ASTM F1267, , Class 1 (uncoated).
- I. Perforated Metal, Uncoated: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- J. Perforated Metal, Galvanized Steel Sheet: ASTM A653/A653M, G90 coating, commercial steel Type B, 0.064 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
- K. Welded-Wire Mesh: Diamond pattern, 2-inch welded-wire mesh, made from 0.236-inch nominal-diameter steel wire complying with ASTM A510/A510M.
- L. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

**2.3 ABRASIVE NOSINGS**

- A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. American Safety Tread Co., Inc.

- b. Balco; a CSW Industrials Company.
  - c. Nystrom.
- 2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
  - 3. Nosings, Square-Back Units: 1-3/8 inches wide, without lip.
  - 4. Abrasive color: Black..

## 2.4 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; and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or adhesive 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.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Zinc-Rich Primer: Comply with SSPC-Paint 20, [Type I-A] [Type I-B] [Type I-C] [Type II], Level [1] [2] [3], and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.

- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with ASTM A780/A780M and compatible with paints specified to be used over it.
- G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
- H. Prefilled Concrete Treads:
  - 1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
  - 2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
  - 3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.
  - 4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
    - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

## 2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, 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, railings, and guards 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 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 #1 - No evidence of welded joint.
- 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 Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Stringers: Fabricate of steel rectangular tubes.
    - 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. Platforms: Construct of steel rectangular tube 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 or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
  - 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. Steel Sheet, Uncoated: Cold -rolled steel sheet.
  2. 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.
  3. 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.
  4. Shape metal pans to include nosing integral with riser.
  5. Attach abrasive nosings to risers.
  6. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
  7. 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.
- D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.097 inch.
1. Steel Sheet: Uncoated, hot-rolled steel sheet unless otherwise indicated.
  2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
  3. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
  4. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.
- 2.8 FABRICATION OF STAIR RAILINGS AND GUARDS
- A. Comply with applicable requirements in Section 057300 "Decorative Metal Railings."
- B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
- C. Welded Connections: Fabricate railings and guards with welded connections.
1. Fabricate connections that are exposed to weather in a manner that excludes water.
    - a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  3. Weld all around at connections, including at fittings.
  4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  5. Obtain fusion without undercut or overlap.
  6. Remove flux immediately.
  7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.
- D. Form changes in direction of railings and guards as follows:
1. As detailed.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing and guard members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- H. Connect posts to stair framing by direct welding unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
  3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
  4. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- 2.9 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.
  - 1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- 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 033000 "Cast-in-Place Concrete."
1. Install abrasive nosings with anchors fully embedded in concrete.
  2. Center nosings on tread width.

### 3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
  3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
  4. Secure posts, rail ends, and guard ends to building construction as follows:
    - a. Anchor posts to steel by welding to steel supporting members.
    - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Install railing gates level, plumb, and secure for full opening without interference.
1. Attach hardware using tamper-resistant or concealed means.
  2. Adjust hardware for smooth operation.
- C. Attach handrails to wall with wall brackets.
1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  2. Secure wall brackets to building construction as required to comply with performance requirements.

**3.4 REPAIR****A. Touchup Painting:**

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed 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 dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

**END OF SECTION**

**SECTION 057300 - DECORATIVE METAL RAILINGS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Steel and iron decorative railings.

**B. Related Requirements:**

1. Section 055213 "Pipe and Tube Railings" for nonornamental railings fabricated from pipes and tubes.

**1.2 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.

**1.3 PREINSTALLATION MEETINGS**

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

**1.4 ACTION SUBMITTALS****A. Product Data:**

1. Manufacturer's product lines of decorative metal railings assembled from standard components.
2. Stainless steel cable and cable fittings.
3. Fasteners.
4. Post-installed anchors.
5. Handrail brackets.
6. Shop primer.
7. Intermediate coats and topcoats.
8. Nonshrink, nonmetallic grout.
9. Anchoring cement.
10. Metal finishes.

- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- 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. Fittings, end caps, and brackets.
  - 3. Welded connections.
  - 4. Cable and cable hardware and connections.
  - 5. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and guard infill. Sample need not be full height.
    - a. Show method of connecting and finishing members at intersections.
- E. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- E. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- F. Preconstruction test reports.

### 1.6 QUALITY ASSURANCE

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

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

**1.8 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 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, are to 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. applied in any direction.
    - b. Concentrated load of 200 lbf 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 applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

**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: 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.

**2.3 STEEL AND IRON DECORATIVE RAILINGS**

- A. Source Limitations: Obtain steel decorative railing components from single source from single manufacturer.



- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- C. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- D. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- E. Plates, Shapes, and Bars: ASTM A36/A36M.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- G. Stainless Steel Cable and Cable Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johnson, C. Sherman, Co., Inc.
    - b. Loos & Co. Inc.
    - c. Ultra-tec; The Cable Connection.
  - 2. Cable: 1-by-19 wire cable made from wire complying with ASTM A492, Type 316,.
  - 3. Cable Diameter: 3/16 inch.
  - 4. Cable Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of cable with which they are used.

## 2.4 FASTENERS

- A. Fastener Materials:
  - 1. Stainless Steel Railing Components: Type 304 stainless steel fasteners.
  - 2. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
  - 3. Finish exposed fasteners to match appearance, including color and texture, of railings.
- 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 and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed

when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2. 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.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593 and nuts, ASTM F594.

## 2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast-aluminum, center of handrail 2-1/4" inches from wall.
  1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Intermediate Coats and Topcoats: Provide products that comply with Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- E. Epoxy Intermediate Coat: Compatible with primer and topcoat.
- 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.
- G. 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.

## 2.6 FABRICATION

- A. 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 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. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- F. Connections: Fabricate railings with welded connections unless otherwise indicated.
- G. 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 #1 welds; ornamental quality with no evidence of a welded joint.
- H. Form changes in direction as follows:
1. As detailed.
- 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 cap and end fittings of same metal and finish as railings.
- K. 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 or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, 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.
- M. 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.
- N. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- O. Stainless Steel Cable Guard Infill: Fabricate cable guard infill assemblies in the shop to field-measured dimensions with fittings machine swaged.
  1. Minimize amount of turnbuckle take-up used for dimensional adjustment, so maximum amount is available for tensioning cable.
  2. Tag cable assemblies and fittings to identify installation locations and orientations for coordinated installation.

## 2.7 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 unacceptable. 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.

## 2.8 STEEL AND IRON FINISHES

- A. 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.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3. SSPC-SP 7/NACE No. 4. requirements indicated below:
  1. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
  2. Other Railings: SSPC-SP 7/NACE No. 4.
- C. 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 099123 "Interior Painting" unless indicated.
  2. Do not apply primer to galvanized surfaces.

- D. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting." Section 099600 "High-Performance Coatings."
  - 1. Color: As indicated by manufacturer's designations.
- E. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.
  - 1. Color: Match Architect's sample.

**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. 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 have been 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.
  - 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.
- 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 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. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. 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 stainless 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. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- D. 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 posts and bolt to metal-supporting surfaces.

**3.5 ATTACHING RAILINGS**

- A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends, using nonwelded connections.
- C. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
  - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.

3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. 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.
5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
6. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

### 3.6 REPAIR

#### A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - a. Apply by spray to provide a minimum 2.0-mil dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

### 3.7 CLEANING

- #### A.
- Clean by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

### 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 057300

**SECTION 061000 - ROUGH CARPENTRY****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Miscellaneous lumber.
5. Plywood backing panels.

**1.2 DEFINITIONS**

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
  2. NLGA: National Lumber Grades Authority.
  3. SPIB: The Southern Pine Inspection Bureau.
  4. WCLIB: West Coast Lumber Inspection Bureau.
  5. WWPA: Western Wood Products Association.

**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 in accordance with 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. Material Certificates:**

1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products 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**

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber 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. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.

**B. Maximum Moisture Content:**

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

**2.2 WOOD-PRESERVATIVE-TREATED LUMBER**

- A. Preservative Treatment by Pressure Process: AWP A U1, Use categories as follows:

1. UC1: Interior construction not in contact with ground or subject to moisture. Include all rough carpentry.
  - a. Wood, blocking, furring, and similar concealed members in contact with masonry or concrete.
  - b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - c. Wood furniture.
  - d. Wood millwork.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. After treatment, redry dimension lumber to 19 percent maximum moisture content.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that 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.
- D. Application: Treat all rough carpentry unless otherwise indicated.

### 2.3 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to 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 in accordance with 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 beyond the centerline of the burners at any time during the test.
  - 1. Treatment is not to promote corrosion of metal fasteners.
  - 2. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
  - 3. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
- E. Application: Treat all rough carpentry unless otherwise indicated.

### 2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Furring.
- B. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
  - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWP.
  3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWP.
  4. Eastern softwoods; No. 2 Common grade; NeLMA.
  5. Northern species; No. 2 Common grade; NLGA.
  6. Western woods; Construction or No. 2 Common grade; WCLIB or WWP.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- 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, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## 2.6 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

**2.7 MISCELLANEOUS MATERIALS****PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. 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.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. 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 o.c.
- E. 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.
- F. 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.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
- H. 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 NAILERS**

- 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

**3.3 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.

END OF SECTION 061000

**SECTION 061600 - SHEATHING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment materials.

**B. Related Requirements:**

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

**1.2 PREINSTALLATION MEETINGS****A. Preinstallation Conference: Conduct conference at Project site.**

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

**1.3 ACTION SUBMITTALS****A. Product Data:**

1. Wall sheathing.
2. Sheathing joint-and-penetration treatment materials.

**B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.**

1. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

**C. Field quality-control reports.****1.4 QUALITY ASSURANCE****A. Testing Agency Qualifications:**

1. 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.

## 1.5 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 in accordance with 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 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  - 2. Type and Thickness: Type X, 5/8 inch thick.
  - 3. Size: 48 by 96 inches for vertical installation.
- B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M, Type X, coated fiberglass mat gypsum sheathing with integral weather-resistant barrier and air barrier complying with ASTM E2178.
  - 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. Georgia-Pacific Gypsum LLC.
    - b. USG Corporation.
  - 2. Thickness: 5/8 inch thick.
  - 3. Size: 48 by 96 inches for vertical installation.
  - 4. Edges: Square.

5. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
6. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference when tested in accordance with ASTM E2178.
7. Vapor Permeance: Minimum 20 perms when tested in accordance with ASTM E96/E96M, Desiccant Method, Procedure A.
8. Sheathing Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested in accordance with ASTM E2357.
9. Fire Propagation Characteristics: Complies with NFPA 285 testing as part of an approved assembly.
10. UV Resistance: Can be exposed to sunlight for 30 days in accordance with manufacturer's written instructions.
11. 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 sheathing 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.

C. Cementitious Backer Units, Walls: ASTM C1325, Type A.

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.**
  - b. **FinPan, Inc.**
  - c. **USG Corporation.**
2. Thickness: 5/8 inch.

## 2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
  2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. 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.



- F. 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 less than 0.0329 inch thick, use screws that comply with ASTM C1002.
  - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.
- G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

### 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 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- D. Coordinate wall 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 INSTALLATION OF GYPSUM SHEATHING

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing with screws.
  - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.

4. Install panels with a 1/4-inch 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. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
  1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- D. 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 o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
- E. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:
  1. Install accessory materials in accordance with sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.
    - a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
    - b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches of coverage is achieved over each substrate.
  2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as 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.
  3. 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.
  4. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
  5. Seal top of through-wall flashings to sheathing with an additional 6-inch-wide, transition strip.
  6. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
  7. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches beyond repaired areas in strip direction.

**SHEATHING**

LXT Eastside Development

**SECTION 06 16 00**

Project #47732472

Permit Set 09/29/22

**3.3 INSTALLATION OF CEMENTITIOUS BACKER UNITS**

- A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

**3.4 FIELD QUALITY CONTROL**

- A. Testing and Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests: As determined by testing agency from among the following tests:
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.

END OF SECTION 061600

**SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

**B. Related Requirements:**

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

**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:**

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

**B. Product Data Submittals: For each product.**

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

**C. 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.
- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.
- E. Samples for Verification: For the following:
1. Plastic Laminates: 8 by 10 inches, 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. Corner Pieces:
    - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    - b. Miter joints for standing trim.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of product.
- C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

#### 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: Manufacturer of products.
  1. 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. 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 with Humidity Control: 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 and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets 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.
  - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

**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: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Formica Corporation.
  - b. Wilsonart LLC.
  - c. Arborite
- F. Exposed Surfaces:
  1. Plastic-Laminate Grade Horizontal Surface: HGS.
  2. Plastic-Laminate Grade Postformed Surface: HGP.
  3. Plastic-Laminate Grade Vertical Surface: HGS.
  4. Edges: Grade HGS.
  5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Semiexposed Surfaces:
  1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.
    - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
    - b. Edges of Thermally Fused Laminate 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, ISO 4586-3, grade to match exposed surface.
  2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
  3. Drawer Bottoms: Thermally fused laminate panels.
- H. Dust Panels: 1/4-inch 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, ISO 4583-3, grade to match exposed surface.
- 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 indicated by laminate manufacturer's designations.
  2. Match Architect's sample.

3. As selected by Architect from laminate manufacturer's full range in the following categories:
  - a. As selected by Architect.

## 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, made with binder containing no urea formaldehyde.
  2. Particleboard (Medium Density): ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
  3. Softwood Plywood: DOC PS 1.
  4. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper, made with adhesive containing no urea formaldehyde.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
  1. Use treated materials that comply with requirements of referenced quality 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 and Plywood: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 beyond the centerline of the burners at any time during the test.
  1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.



2. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
- C. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less in accordance with ASTM E84.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following or equal:
    - a. Roseburg.

#### 2.4 CABINET HARDWARE AND ACCESSORIES

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."
- B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
  1. Semiconcealed Hinges for Flush Doors: ANSI/BHMA A156.9, B01361.
  2. Semiconcealed Hinges for Overlay Doors: ANSI/BHMA A156.9, B01521.
- C. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening.
- D. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- E. Pulls: Per drawings
- F. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- G. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- H. Shelf Rests: ANSI/BHMA A156.9, B04013; two-pin metal with shelf hold-down clip.
- I. Drawer Slides: ANSI/BHMA A156.9.
  1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
    - a. Type: Full extension.
    - b. Material: Galvanized steel ball bearing slides.
    - c. Motion Feature: Soft close dampener.
  2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
  3. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
  4. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.

5. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
6. Computer keyboard tray, provide 75 lb load capacity.
- J. Slides for Sliding Glass Doors: ANSI/BHMA A156.9, B07063; aluminum.
- K. Door Locks: ANSI/BHMA A156.11, E07121.
- L. Drawer Locks: ANSI/BHMA A156.11, E07041.
- M. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- N. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
  1. Thickness: 4.0 mm.
- O. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.
  1. Unframed Glass Doors: Seam exposed edges seamed before tempering.
- P. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.
- Q. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
  1. Color: White.
- R. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
  1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
  2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
  3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
  4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
  5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
  6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
  7. Satin Stainless Steel: ANSI/BHMA 630.
- S. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

**2.5 MISCELLANEOUS MATERIALS**

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood 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: Type I, waterproof type as selected by fabricator to comply with requirements.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

**2.6 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.
- D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."
  - 1. For glass in frames, secure glass with removable stops.
  - 2. For exposed glass edges, polish and grind smooth.

**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. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- B. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

- C. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches 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 o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

### 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 is to 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 064116

**SECTION 072100 - THERMAL INSULATION****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Sound attenuation Glass-fiber blanket insulation.

**B. Related Requirements:**

1. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
2. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

**1.2 ACTION SUBMITTALS****A. Product Data** For each type of product indicated.**1.3 INFORMATIONAL SUBMITTALS**

- A. **Installer's Certification:** Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
- B. **Product Test Reports:** For each product, for tests performed by a qualified testing agency.
- C. **Research Reports:** For foam-plastic insulation, from ICC-ES.

**1.4 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 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; 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 listings of another qualified testing agency.
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

**2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION**

- A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DuPont de Nemours, Inc.
    - b. Owens Corning.
    - c. The Dow Chemical Company.

**2.3 GLASS-FIBER BLANKET INSULATION**

- A. Glass-Fiber Blanket Insulation, Polypropylene-Scrim-Kraft Faced: ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
  - 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.

- B. Glass-Fiber Blanket Insulation, Kraft Faced: ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

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.

## 2.4 SOUND ATTENUATION GLASS-FIBER BLANKET INSULATION

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Unfaced, Glass-Fiber Blanket Insulation: 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.
- C. Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
  2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

## 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. AGM Industries, Inc.
  - b. Gemco.
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-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 square or in diameter.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. AGM Industries, Inc.
  - b. Gemco.

- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGM Industries, Inc.
    - b. Gemco.

## 2.6 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
  - 2. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.
    - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
      - 1) Huntsman Building Solutions.

## 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 SLAB INSULATION**

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

**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 clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
  - 5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
  - 6. For wood-framed construction, install blankets in accordance with ASTM C1320 and as follows:
    - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.
  - 7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
    - a. Exterior Walls: Set units with facing placed toward interior of construction.
    - b. Interior Walls: Set units with facing placed toward areas of high humidity.
- 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..
  - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

- C. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.
  - 1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
  - 2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."
- D. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation according to manufacturer's written instructions.
  - 1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
  - 2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

### 3.5 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.
  - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass.
  - 2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
  - 3. Install insulation to fit snugly without bowing.

### 3.6 INSTALLATION OF REFLECTIVE INSULATION

- A. Install sheet reflective insulation in accordance with ASTM C727.
- B. Install sheet radiant barriers in accordance with ASTM C1744.
- C. Install interior radiation control coating system in accordance with ASTM C1321.

### 3.7 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. 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 072100

**SECTION 072500 - WEATHER BARRIERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Building wrap.
  - 2. Flexible flashing.

**1.2 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Building wrap.
  - 2. Flexible flashing.
- B. Product Data Submittals: For building wrap, include data on air and water-vapor permeance based on testing in accordance with referenced standards.
- C. Shop Drawings: Show details of building wrap at terminations, openings, and penetrations. Show details of flexible flashing applications.
- D. Sustainable Design Submittals:

**1.3 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

**PART 2 - PRODUCTS****2.1 WATER-RESISTIVE BARRIER**

- A. Building Wrap: ASTM E2556/E2556M, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Alpha ProTech.
    - b. DuPont de Nemours, Inc.
    - c. Kingspan Insulation LLC.
  - 2. Water-Vapor Permeance: Minimum 75 perms per ASTM E96/E96M, Desiccant Method (Procedure A).

3. Air Permeance: Maximum 0.004 cfm/sq. ft. at 0.3-inch wg when tested in accordance with ASTM E2178.
4. Allowable UV Exposure Time: Not more than 120 days.
5. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.

## 2.2 FLEXIBLE FLASHING

- A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber 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.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Alpha ProTech.
    - b. DuPont de Nemours, Inc.
    - c. Kingspan Insulation LLC.
  2. Flame Propagation Test: Materials and construction to be as tested in accordance with NFPA 285.
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F1667.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF WATER-RESISTIVE BARRIER

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
  1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
  2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap or Drainage Wrap: Comply with manufacturer's written instructions and warranty requirements.
  1. Seal seams, edges, fasteners, and penetrations with tape.
  2. Extend into jambs of openings and seal corners with tape.

**3.2 INSTALLATION OF FLEXIBLE FLASHING**

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
  - 1. Prime substrates as recommended by flashing manufacturer.
  - 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
  - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
  - 4. Lap water-resistive barrier over flashing at heads of openings.
  - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

**3.3 INSTALLATION OF DRAINAGE MATERIAL**

- A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500

**SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Medium-build air barriers, vapor permeable.

**B. Related Requirements:**

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.
2. Section 072500 "Weather Barriers" for weather barriers, including flexible flashing.

**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.

#### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

#### 1.8 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.

#### 1.9 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. 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., 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. pressure difference; ASTM E2178.
- D. Ultimate Elongation: Minimum 250 percent; ASTM D412, Die C.
- E. Adhesion to Substrate: Minimum 16 lbf/sq. in. 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 over smooth, void-free substrates.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. DuPont de Nemours, Inc.
    - c. Sto Corp.
  - 2. Vapor Permeance: Minimum 5 perms ASTM E96/E96M, Procedure A, Desiccant 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 thick, and Series 300 stainless steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pecora Corporation.
    - b. The Dow Chemical Company.
    - c. Tremco Incorporated.

**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 or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. 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.
- G. 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.
- H. Bridge isolation joints expansion joints and 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 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 of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
  - 1. Transition Strip: Roll firmly to enhance adhesion.
  - 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- 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-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 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 two 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. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. 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.
- D. Tests: As determined by testing agency from among the following tests:
  - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber pressurization or depressurization with smoke tracers.
  - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783.
  - 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. of installed air barrier or part thereof.
- E. 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.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

- G. 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 072726

**SECTION 074213.13 - FORMED METAL WALL PANELS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Concealed-fastener, lap-seam metal wall panels.
  2. Metal liner 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: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
1. Exposed-fastener, lap-seam metal wall panels.
  2. Concealed-fastener, lap-seam metal wall panels.
  3. Metal liner panels.
- B. Shop Drawings:

1. 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.
  2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
1. Include Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For concealed-fastener, lap-seam metal wall panels for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels 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 with minimum five years of experience.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

#### 1.7 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.

## 1.8 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.

## 1.9 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.

## 1.10 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: Five 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 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to 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. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 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. when tested according to ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- 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, ambient; 180 deg F, material surfaces.

**2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS**

- A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels MP-1: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Berridge Manufacturing Company.
    - b. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
    - c. CENTRIA, a Nucor Brand.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

- a. Nominal Thickness: 0.022 inch.
- b. Exterior Finish: Two-coat fluoropolymer.
- c. Surface: Smooth, flat
- d. Color: Per the drawings.

## 2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. 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 MP-2 & MP-3: 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. Berridge Manufacturing Company.
    - b. PAC-CLAD; Petersen; a Carlisle company.
    - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.022 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Surface: Smooth, flat
    - d. Color: Per the drawings.
- C. Flush-Profile, Concealed-Fastener Metal Wall Panels MP-4: Formed with horizontal 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. Berridge Manufacturing Company.
    - b. PAC-CLAD; Petersen; a Carlisle company.
    - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.022 inch.

- b. Exterior Finish: Two-coat fluoropolymer.
  - c. Surface: Smooth, flat
  - d. Color: Per the drawings.
- D. Flush-Profile, Concealed-Fastener Metal Wall Panels MP-5: 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. Berridge Manufacturing Company.
    - b. PAC-CLAD; Petersen; a Carlisle company.
    - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.022 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Surface: Stucco
    - d. Color: Per the drawings.

## 2.4 METAL LINER PANELS

- A. Provide factory-formed metal liner panels designed for interior side walls and 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 a complete installation.
- B. Metal Liner Panels: Solid panels formed with intermediate stiffening ribs symmetrically spaced between panel edges; with a flush joint between panels.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Berridge Manufacturing Company.
    - b. CENTRIA, a Nucor Brand.
    - c. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.022 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.

- c. Color: As selected by Architect from manufacturer's full range.
- 3. Panel Coverage: 36 inches.
- 4. Seam Profile: Flush.
- 5. Seam Height: 1.5 inches.

## 2.5 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 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-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. 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 wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C920; 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 C1311.

**2.6 FABRICATION**

- A. 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. 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 wall panel manufacturer for application but not less than thickness of metal being secured.

**2.7 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 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.
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.

## 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 framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  2. 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 C754 and metal panel manufacturer's written recommendations.

### 3.3 INSTALLATION OF METAL PANELS

- A. 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.
  2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
  3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
  4. Stainless Steel Panels: Use stainless steel fasteners.
- 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. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
  2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Metal Liner Panels: Install panels on interior side of girts with flush appearance on the inside.

- G. 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.
- H. 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 with no joints allowed within 24 inches 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 deep, filled with mastic sealant (concealed within joints).

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. 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.



**FORMED METAL WALL PANEL****SECTION 07 42 13.13**

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- 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 074213.13

**SECTION 074293 - SOFFIT PANELS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Metal soffit panels.

**B. Related Requirements:**

1. Section 074213.13 "Formed Metal Wall Panels" for lap-seam metal wall panels.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS****A. Product Data:**

1. Metal soffit panels.

**B. Product Data Submittals:**

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

**C. Shop Drawings:**

1. 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.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

**D. Samples for Verification:** For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

**1.4 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For Installer.

- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels 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. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- C. 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 4 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.

#### 1.7 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.

**1.8 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.

**1.9 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.

**1.10 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 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to 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. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

- 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. when tested according to ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- 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, ambient; 180 deg F, material surfaces.

## 2.2 METAL SOFFIT PANELS

- A. 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. Metal Soffit Panels: Match profile and material of metal wall panels.
  - 1. Finish: As indicated on Drawings.
- C. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced 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. Berridge Manufacturing Company.
    - b. CENTRIA, a Nucor Brand.
    - c. Dimensional Metals, Inc.
  - 2. Material: Same material, finish, and color as metal fascia panels.
  - 3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.022 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: Per the drawings.
  - 4. Panel Coverage: 12 inches.

5. Panel Height: 1.0 inch.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 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-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 wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; 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 C1311.

## 2.4 FABRICATION

- A. 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. 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 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.
- D. Aluminum Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 2605. 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.

2. Exposed Anodized Finish:
  - a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, 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, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
- 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 C754 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 INSTALLATION OF METAL SOFFIT PANELS

- A. 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.
2. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.
4. Stainless Steel Panels: Use stainless steel fasteners.

**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. Watertight Installation:****F. 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.

**G. 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 with no joints allowed within 24 inches 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 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 074293

**SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Vapor retarder.
4. Roof insulation.
5. Insulation accessories and cover board.

**B. Related Requirements:**

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for roof edge flashings.
6. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint assemblies.
7. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

**1.2 DEFINITIONS**

- A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

**1.3 PREINSTALLATION MEETINGS**

- A. Preliminary Roofing Conference: Before starting roof deck construction, 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. Review deck substrate requirements for conditions and finishes, 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.

**B. 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:**

1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories and cover board.
5. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

**B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:**

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.

4. Tapered insulation layout, thickness, and 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. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  7. 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 manufacturer.
- 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 compliance 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, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field Test Reports:
1. Concrete internal relative humidity test reports.
  2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- F. Field quality-control reports.
- G. 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 or listed in FM Approvals' or RoofNav listed in SPRI's Directory of Roof Assemblies 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. Protect stored liquid material from direct sunlight.
  - 1. 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. Store in a dry location. 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, vapor retarder, substrate board, 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, on warranty form at end of this Section, 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, substrate boards, and, 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 to 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 to remain watertight.
  1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
  2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials to 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: Refer to drawings.
- D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
  1. Fire/Windstorm Classification: Class 1A-120.
  2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 VSH.
- E. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

### 2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

- A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed self-adhering TPO sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carlisle Syntec Systems.
  - b. GAF.
  - c. Johns Manville; a Berkshire Hathaway company.
2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.
3. Thickness: 60 mils, nominal.
4. Exposed Face Color: Gray.

### 2.3 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
  1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Roof Vents: As recommended by roof membrane manufacturer.
  1. Size: Not less than 4-inch diameter.
- E. Bonding Adhesive: Manufacturer's standard.
- F. Slip Sheet: Manufacturer's standard, of thickness required for application.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
- I. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.
  1. Fasteners: 1-1/2-inch stainless steel fasteners with neoprene washers.
- J. 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, and acceptable to roofing system manufacturer.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.



**2.4 ROOF INSULATION**

- A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer.
- B. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.45-lb/cu. ft. minimum density, 25 psi minimum compressive strength, square edged.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kingspan Insulation LLC.
    - b. Owens Corning.
    - c. The Dow Chemical Company.
  - 2. Thermal Resistance: R-value of 5.0 per 1 inch.
  - 3. Size: 48 by 48 inches.
  - 4. Thickness:
    - a. Base Layer: 1 inches.

**2.5 INSULATION ACCESSORIES AND COVER BOARD**

- 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 with 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. Induction-Welding Plates: Minimum 3-inch diameter with recessed center, 0.034-inch thick, aluminum-zinc-alloy-coated steel plates, factory-coated with adhesive formulated for roof membrane, with corresponding corrosion-resistant fasteners.
- D. 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.
- E. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  - 2. Thickness: 1/4 inch.
  - 3. Surface Finish: Fiberglass facer.

**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 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 Section 053100 "Steel Decking."
- 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 system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

**3.3 INSTALLATION OF ROOFING, GENERAL**

- A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof 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 end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.
- C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

**3.4 INSTALLATION OF INSULATION**

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

**C. Installation Over Metal Decking:**

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
  - a. Locate end joints over crests of decking.
  - b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
  - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - e. 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.
    - 1) Trim insulation so that water flow is unrestricted.
  - f. Fill gaps exceeding 1/4 inch with insulation.
  - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - h. Loosely lay base layer of insulation units over substrate.
  - i. 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 according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
    - 2) 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 from previous layer of insulation.
  - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
  - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
  - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - e. 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.
    - 1) Trim insulation so that water flow is unrestricted.
  - f. Fill gaps exceeding 1/4 inch with insulation.
  - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - h. Loosely lay each layer of insulation units over substrate.
  - i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

- 1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F of equiviscous temperature.
- 2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
- 3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### 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 in each direction.
  1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. Cut and fit cover board tight to nailers, projections, and penetrations.
  3. Loosely lay cover board over substrate.
  4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
    - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - b. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- B. Install slip sheet over cover board and beneath roof membrane.
- C. Place plates on insulation in required fastening patterns to achieve FM rating and secure in accordance with manufacturer's instructions.
  1. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch minimum into roof deck; do not overdrive fasteners.

### 3.6 INSTALLATION OF MECHANICALLY FASTENED ROOF MEMBRANE

- A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

- E. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- G. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.
- H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
  - 2. Verify field strength of seams a minimum of once daily, and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

### 3.7 INSTALLATION OF INDUCTION-WELDED ROOF MEMBRANE

- A. Unroll roof membrane and allow to relax before installing.
- B. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer, with side laps shingled with slope of roof deck where possible.
- C. Seams: Clean seam areas, overlap roof membrane, and hot-air-weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity.
  - 2. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
  - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- D. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.
- E. Induction-weld roof membrane to plates in accordance with roofing system manufacturer's written instructions, creating 100 percent bond between underside of membrane and top of plates; a partial bond is unacceptable.
  - 1. Test welds to verify adhesion of roof membrane to top of plates in accordance with membrane manufacturer's instructions.

**3.8 INSTALLATION OF BASE FLASHING**

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

**3.9 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Perform the following tests:
  - 1. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D5957, 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 with a minimum depth of and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
    - c. Flood each area for 24 48 72 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 Contractor's responsibility.
    - e. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.
- C. 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.
- D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

### 3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, 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.

### 3.11 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS \_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
  - 1. Owner: .
  - 2. Owner Address: .
  - 3. Building Name/Type: .
  - 4. Building Address: .
  - 5. Area of Work: .
  - 6. Acceptance Date: \_\_\_\_\_.
  - 7. Warranty Period: .
  - 8. Expiration Date: \_\_\_\_\_.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - 1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
    - a. lightning;

- 3.12 peak gust wind speed exceeding" SUBSTRATE BOARD
- a. : Per the drawings.
  - b. fire;
  - c. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
  - d. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
  - e. vapor condensation on bottom of roofing; and
  - f. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
  4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
  5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
  6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
  7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

B. IN WITNESS THEREOF, this instrument has been duly executed this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

1. Authorized Signature: \_\_\_\_\_.
2. Name: \_\_\_\_\_.
3. Title: \_\_\_\_\_.



**THERMOPLASTIC POLYOLEFIN (TPO) ROOFING**

LXT Eastside Development

**SECTION 07 54 23**

Project #47732472

Permit Set 09/29/22

END OF SECTION 075423

**SECTION 076200 - SHEET METAL FLASHING AND TRIM****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Wall sheet metal fabrications.
4. Miscellaneous sheet metal fabrications.

**B. Related Requirements:**

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 075423 Thermoplastic-Polyolefin (TPO) Roofing for roofing installation of sheet metal flashing and trim integral with roofing.
3. Section 074213.13 - Formed Metal Wall Panels for sheet metal flashing and trim integral with metal wall panels.
4. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, and counterflashings.
5. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

**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 PREINSTALLATION MEETINGS****A. Preinstallation Conference: Conduct conference at Project site.**

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

**1.4 ACTION SUBMITTALS****A. Product Data:**

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Steep-slope roof sheet metal fabrications.
4. Wall sheet metal fabrications.
5. Miscellaneous sheet metal fabrications.

**B. Product Data Submittals:**

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

**C. Shop Drawings: For sheet metal flashing and trim.**

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

**D. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.****1.5 INFORMATIONAL SUBMITTALS****A. Qualification Data: For fabricator.****B. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.****C. Product Test Reports: For each product, for tests performed by a qualified testing agency.****D. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.**

- E. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

#### 1.7 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. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

#### 1.8 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.

#### 1.9 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 E 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. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings & roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- D. FM Approvals Listing: Manufacture and install copings & roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- E. 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, ambient; 180 deg F, material surfaces.

**2.2 SHEET METALS**

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; 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: Per the drawings.

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.

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.
  1. Source Limitations: Obtain underlayment from single source from single manufacturer.
- C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    - b. Henry Company; a Carlisle company.
    - c. Owens Corning.
  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 or lower.
- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, 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 or manufactured item.
  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 Aluminum Sheet: Aluminum or Series 300 stainless steel.
- 3. 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/F2329M.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. 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.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

## 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 on slope and location lines indicated on Drawings and within 1/8-inch 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 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. Tin edges to be seamed, form seams, and solder.
  - 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- 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-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 Insert dimension.
  - 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 B in accordance with cited sheet metal standard.
  - 6. Expansion Joints: Butt type with cover plate.
  - 7. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:
    - a. Galvanized Steel: 0.040 inch thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
  - 1. Fabricated Hanger Style: Fig. 1-35B in accordance with SMACNA's "Architectural Sheet Metal Manual."
  - 2. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.



- C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch 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,. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- E. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
  - 1. Aluminum: 0.040 inch thick.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
  - 1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
  - 2. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-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-wide, concealed backup plate.
  - 3. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
  - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

**2.8 WALL SHEET METAL FABRICATIONS**

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: 0.0156 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: 0.0156 inch thick.

**2.9 MISCELLANEOUS SHEET METAL FABRICATIONS**

- A. Equipment Support Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.0188 inch thick.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
  - 1. Stainless Steel: 0.0250 inch 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. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
  - 1. Install in shingle fashion to shed water.
  - 2. Lap joints not less than 2 inches.

- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
  - 1. Lap horizontal joints not less than 4 inches.
  - 2. Lap end joints not less than 12 inches.
- C. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.
  - 1. Install in shingle fashion to shed water.
  - 2. Lapp joints not less than 4 inches.

### 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 o.c.
  - 6. Space individual cleats not more than 12 inches 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. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  - 2. 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 with no joints within 24 inches of corner or intersection.

2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- 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 into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F, 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.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "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 riveted and soldered joints.
  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. Slope to downspouts.
  6. Fasten gutter spacers to front and back of gutter.
  7. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
  8. Anchor gutter with gutter brackets straps spaced not more than 36 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
  9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts:
  1. Join sections with 1-1/2-inch 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 o.c.

4. Connect downspouts to underground drainage system.

D. Splash Pans:

1. Install where downspouts discharge on low-slope roofs.
2. 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 below scupper discharge.

G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches 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 centers.

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 centers.
  - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch 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. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
  1. Extend counterflashing 4 inches over base flashing.
  2. Lap counterflashing joints minimum of 4 inches.
  3. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant or interlocking folded seam or blind rivets and sealant unless otherwise indicated.
- F. 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 WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

### 3.7 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.
- B. Overhead-Piping Safety Pans:
  1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
  2. Pipe and install drain line to plumbing waste or drainage system.

### 3.8 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

**3.9 CLEANING**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

**3.10 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 076200

**SECTION 077253 - SNOW GUARDS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Rail-type, seam-mounted snow guards.

**1.2 ACTION SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 1. Rail-type, seam-mounted snow guards.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
  - 1. Include details of rail-type snow guards.
- C. Samples:
  - 1. Rail-Type Snow Guards: Bracket, 12-inch-long rail, and installation hardware.
    - a. For units with factory-applied finishes, submit manufacturer's standard color selections.
- D. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Include calculation of number and location of snow guards.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the state in which the Project is located.
- B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

**1.4 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.



**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, as applicable for attachment method, based on the following:
1. Roof snow load.
  2. Snow drifting
  3. Roof slope.
  4. Roof type.
  5. Roof dimensions.
  6. Roofing substrate type and thickness.
  7. Snow guard type.
  8. Snow guard fastening method and strength.
  9. Snow guard spacing.
  10. Coefficient of Friction Between Snow and Roof Surface: 0.
  11. Factor of Safety: 2.
- B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Snow Loads: As indicated on Drawings.

**2.2 RAIL-TYPE SNOW GUARDS**

- A. Rail-Type, Seam-Mounted Snow Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Alpine SnowGuards.
    - b. IceBlox Inc.
    - c. Rocky Mountain Snow Guards, Inc.
    - d. Approved equal
  2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with one rail.
  3. Brackets and Baseplate: ASTM B209 aluminum; mill finished or ASTM B209 aluminum; clear anodized.
  4. Bars: ASTM B221 aluminum; mill finish or ASTM B221 aluminum, clear anodized.

- a. Profile: Round or Square.
- 5. Seam Clamps: ASTM B221 aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
  - 1. 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 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions.
  - 1. Space rows as recommended by manufacturer.
- B. Attachment for Standing-Seam Metal Roofing:
  - 1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
  - 2. Rail-Type, Seam-Mounted Snow Guards:
    - a. Install brackets to vertical ribs in straight rows.
    - b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
    - c. Torque set screw in accordance with manufacturer's written instructions.
    - d. Install cross members to brackets.
- C. Attachment for Exposed Fastened Metal Roofing:
  - 1. Do not use fasteners that will void metal roofing finish warranty.
  - 2. Rail-Type, Flat-Mounted Snow Guards:
    - a. Install brackets in straight rows.
    - b. Mechanically fasten to metal roofing, using sealant and mechanical fasteners identical to those used to secure metal roofing to substrate.
    - c. Install cross members to brackets.

**SNOW GUARDS**

LXT Eastside Development

**SECTION 07 72 53**

Project #47732472

Permit Set 09/29/22

END OF SECTION 077253

**SECTION 078443 - JOINT FIRESTOPPING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Joints in or between fire-resistance-rated construction.

**B. Related Requirements:**

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies.
2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS****A. Product Data:**

1. Joints in or between fire-resistance-rated construction.

- 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 developed in accordance with current International Firestop Council (IFC) guidelines.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

- B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

**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 FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

**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.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. 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 firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.

- 1) UL in its online directory "Product iQ."

## 2.3 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 must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
  1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
  2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
  3. Provide firestop products that do not contain ethylene glycol.
- B. Intumescent Gypsum Wall Framing Gaskets (Applied to Steel Tracks, Runners, and Studs prior to Framing Installation): Provide products with fire, smoke, and acoustical ratings that allow movement up to 100 percent compression and/or extension in accordance with UL 2079 or ASTM E1966; have an L Rating less than 1 cfm/ft. in accordance with UL 2079; and a minimum Sound Transmission Class (STC) rating of 56 in accordance with ASTM E90 or ASTM C919.
- C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 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 Building and Construction.
    - b. Hilti, Inc.
    - c. Tremco Incorporated.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

## 2.4 ACCESSORIES

- A. Provide components of joint firestopping 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 joint firestopping 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.
- C. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

**3.3 INSTALLATION**

- A. General: Install joint firestopping 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 joint firestopping 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. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 ft. from end of wall and at intervals not exceeding 30 ft..
- B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches 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. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.
- 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 joint firestopping systems immediately and install new materials to produce joint firestopping 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 online directory "Product iQ" under product Category XHBN or Category XHDG.
- B. Wall-to-Wall, Joint Firestopping Systems: .
  - 1. UL-Classified Systems: WW-D S- 0000-0999.
  - 2. Assembly Ratings: 1 hour and 2 hours.
  - 3. Nominal Joint Width: As indicated.
  - 4. Movement Capabilities: Class I – 50 percent compression or extension.
- C. Floor-to-Wall, Joint Firestopping Systems: .
  - 1. UL-Classified Systems: FW- S- 0000-0999.
  - 2. Assembly Rating: 1 hour and 2 hours.
  - 3. Nominal Joint Width: As indicated.
- D. Head-of-Wall, Fire-Resistive Joint Firestopping Systems: .
  - 1. UL-Classified Systems: HW- S-Insert four-digit number 0000-0999.
  - 2. Assembly Rating: 1 hour 2 hours.
  - 3. Nominal Joint Width: As indicated.
  - 4. Movement Capabilities: Class I - 50 percent compression or extension.

END OF SECTION 078443

**SECTION 079200 - JOINT SEALANTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Joint-sealants.
2. Joint sealant backing materials.

**B. Samples for Initial Selection:** Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.**C. Samples for Verification:** For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.**D. 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 QUALITY ASSURANCE****A. Qualifications:**

1. Installers: Authorized representative who is trained and approved by manufacturer.

**1.4 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.
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.

## 1.5 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: Five years from date of Substantial Completion.
- 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 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

### 2.2 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.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

**2.3 SILICONE JOINT SEALANTS**

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Adfast Corp.
  - b. GE Construction Sealants; Momentive Performance Materials Inc.
  - c. Pecora Corporation.
  - d. Sika Corporation.
- B. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Adfast Corp.
  - b. Pecora Corporation.
  - c. Sika Corporation.
  - d. The Dow Chemical Company.
- C. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Soudal USA.
  - b. The Dow Chemical Company.
- D. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Pecora Corporation.
  - b. Sika Corporation.

**2.4 NONSTAINING SILICONE JOINT SEALANTS**

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast Corp.
    - b. Pecora Corporation.
    - c. Sika Corporation.
- C. 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 C920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adfast Corp.
    - b. GE Construction Sealants; Momentive Performance Materials Inc.
    - c. Pecora Corporation.
    - d. Sika Corporation.
    - e. The Dow Chemical Company.

## 2.5 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, provide products by one of the following:
    - a. Adfast Corp.
    - b. Alcot Plastics Ltd.
    - c. Construction Foam Products; a division of Nomaco, Inc.
    - d. Master Builders Solutions.
- B. Cylindrical Sealant Backings: ASTM C1330, 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.

**2.6 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type 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 in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

### 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 joint sealants and of products in which joints occur.

### 3.5 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.

### 3.6 JOINT-SEALANT SCHEDULE

- A. Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-1:
  1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of walls and partitions.
  2. Joint Sealant: Silicone, S, NS, 50, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-2:
  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 windows.
  2. Joint Sealant: Silicone, S, NS, 50, NT
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200



**SECTION 081113 - 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.

**B. Related Requirements:**

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

**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 ACTION SUBMITTALS****A. Product Data:**

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

**B. Product Data Submittals:** For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

**C. 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.

- D. 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.

## 1.5 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 and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.
- C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.
- D. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

## 1.7 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to 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.
- B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to 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. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 HOLLOW METAL DOORS AND FRAMES

- 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. Ceco Door; AADG, Inc.; ASSA ABLOY.
  2. Curries, AADG, Inc.; ASSA ABLOY Group.
  3. Steelcraft; Allegion plc.

### 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 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. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- 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. 0.40 deg Btu/F x h x sq. ft. 0.38 deg Btu/F x h x sq. ft. Insert U-factor when tested in accordance with ASTM C1363 or ASTM E1423.

**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. Type: As indicated in the Door and Frame Schedule on Drawings.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Core: Manufacturer's standard.
    - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Knocked down.
  - 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. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule on Drawings.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
    - d. Edge Construction: Model 1, Full Flush.
    - 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: Manufacturer's standard.

- i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
2. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
  - b. Construction: Knocked down.
3. Exposed Finish: Prime Factory.

## 2.5 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Knocked down.
- 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 of frame height above 7 feet.
  3. Postinstalled Expansion Anchor: Minimum 3/8-inch-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 height adjustment. Terminate bottom of frames at top of underlayment.

- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z 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 088000 "Glazing."

## 2.9 FABRICATION

- A. 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 and Transom Bar 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.
- B. 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 on Drawings, 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.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with square 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 o.c. and not more than 2 inches 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. 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, NAAMM-HMMA 840.

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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, 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, NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
  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 088000 "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. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

**SECTION 081416 - FLUSH WOOD DOORS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Light frames

**B. Related Requirements:**

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.

**B. Product Data Submittals: For each product, including the following:**

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Factory-machining criteria.
6. Factory- finishing specifications.

**C. Sustainable Design Submittals:****D. 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 frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Doors to be factory finished and application requirements.
9. Apply AWI Quality Certification WI Certified Compliance Program label to Shop Drawings.

E. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, 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. Qualification Data: For door inspector.

1. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

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. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies complies with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

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.

D. Do not deliver doors until building interior environmental conditions are maintained to meet Manufacturer's requirements for relative humidity.

E. Do not place other items on top of stored doors.

F. Do not drag doors across one another or across other surfaces.

- G. Handle doors using clean gloves.
- H. Protect doors in place as necessary to prevent scratches, dents, and other damage.

## 1.7 FIELD CONDITIONS

### A. Environmental Limitations:

- 1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
- 2. 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 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 in a 42-by-84-inch section.
  - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
- 2. Warranty also includes 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 SOURCE LIMITATIONS

- A. Obtain flush wood doors from single manufacturer.

### 2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

#### A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WT's "Architectural Woodwork Standards."

- 1. Provide labels and certificates from AWI certification program indicating that doors comply with requirements of grades specified.

2. 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.

## 2.3 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

### A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Algoma
  - b. Marshfield
  - c. Eggers
2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty & Standard Duty.
3. Performance Grade by Location:
  - a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Classrooms public toilets janitor's closets assembly spaces.
  - b. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets).
4. ANSI/WDMA I.S. 1A Quality Grade: Premium.
5. Architectural Woodwork Standards Quality Grade: Premium.
6. Faces: Single-ply wood veneer not less than 1/50 inch thick.
  - a. Species: Cherry.
  - b. Cut: Plain sliced (flat sliced).
  - c. Match between Veneer Leaves: Book match.
  - d. Assembly of Veneer Leaves on Door Faces: running match.
  - e. Pair and Set Match: Provide for doors hung in same opening.
  - f. Room Match:
    - 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
    - 2) Provide door faces of compatible color and grain within each separate room or area of building.
7. Exposed Vertical and Top Edges:
  - a. Same species as faces
    - 1) Vertical edge: 1-3/8 inch hardwood to match face veneer.
    - 2) Top and bottom edges: 1-1/8 inch hardwood or composite lumber. No particleboard allowed.
8. Core for Non-Fire-Rated Doors:
  - a. ANSI A208.1, Grade LD-1 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as follows:

- a) 5-inch top-rail blocking, in doors indicated to have closers.
  - b) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
  - c) 5-inch midrail blocking, in doors indicated to have exit devices.
- 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 087100 "Door Hardware."
- b. Glued wood stave.
  - c. WDMA I.S. 10 structural composite lumber.
    - 1) Screw Withdrawal, Door Face: 550 lbf.
    - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
  - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.4 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: Flush rectangular beads Recessed tapered beads Recessed tapered beads with exposed banding Lipped tapered beads Manufacturer's standard shape.

## 2.5 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. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  - 3. 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 088000 "Glazing."

## 2.6 FACTORY PRIMING

## 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. Factory finish doors that are indicated on Drawings to receive transparent finish.
- D. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
  1. Architectural Woodwork Standards Grade: Premium.
    - a. System-5, Varnish, Conversion.
    - b. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
    - c. System-10, UV Curable, Water Based.
    - d. System-11, Polyurethane, Catalyzed.
  2. ANSI/WDMA I.S. 1A Grade: Premium.
    - a. TR-4 Conversion Varnish.
    - b. TR-6 Catalyzed Polyurethane.
    - c. TR-8 UV Cured Acrylated Polyester/Urethane.
  3. Staining: As selected by Architect from manufacturer's full range.
  4. 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 087100 "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. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
  2. Anchor frames to anchors or blocking built in or directly attached to substrates.
    - a. Secure with countersunk, concealed fasteners and blind nailing.
    - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
      - 1) For factory-finished items, use filler matching finish of items being installed.
- D. Job-Fitted Doors:
1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
  2. Machine doors for hardware.
  3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  4. Clearances:
    - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
  5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. 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. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WT's "Architectural Woodwork Standards" for the specified grade.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
  - 3. 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.

**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 081416

**SECTION 083113 - ACCESS DOORS AND FRAMES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Access doors and frames.

**B. Related Requirements:**

1. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

**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.

**B. Product Schedule:** For access doors and frames.**1.3 INFORMATIONAL SUBMITTALS****PART 2 - PRODUCTS****2.1 ACCESS DOORS AND FRAMES****A. Recessed Access Doors with Concealed Flanges:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Babcock-Davis.
  - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
  - c. Nystrom, Inc.
2. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. Optional Features: Piano hinges.
4. Locations: Ceiling.
5. Door Size: Per the drawings.
6. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
7. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory primed.

8. Latch and Lock: Cam latch, screwdriver operated.

## 2.2 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. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- 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.

## 2.3 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.
  2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
- E. Latch and Lock Hardware:
  1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

## 2.4 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.
  - 2. Bright, Cold-Rolled, Unpolished Finish: ASTM A480/A480M No. 2B.

**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. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

**3.4 ADJUSTING**

- A. Adjust doors and hardware, after installation, for proper operation.

**END OF SECTION 083113**

**SECTION 083323 - OVERHEAD COILING DOORS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Fire-rated service doors.

**B. Related Requirements:**

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for finish painting of factory-primed 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, and other accessories.
6. Include diagrams for power, signal, and control wiring.

**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For Installer.

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 is to 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.

#### 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.

**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. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
  - 3. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

**2.3 FIRE-RATED DOOR ASSEMBLY**

- A. Fire-Rated Insulated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cookson; a CornellCookson company.
    - b. Cornell; a CornellCookson company.
    - c. Overhead Door Corporation.
    - d. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. 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: Per the drawings.
- D. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.
- E. STC Rating: 27.
- F. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- G. Insulated Door Assembly U-Factor: 0.90 Btu/deg F x h x sq. ft..
- H. Door Curtain Material: Galvanized steel.
- I. Door Curtain Slats: Flat profile slats of center-to-center height.
  - 1. Insulated-Slat Interior Facing: Metal.

- J. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- K. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- L. Hood: Match curtain material and finish.
  - 1. Shape: Round.
  - 2. Mounting: As indicated on Drawings.
- M. Locking Devices: Equip door with locking device assembly and chain lock keeper.
  - 1. Locking Device Assembly: Single-jamb side locking bars, operable from.
- N. Electric Door Operator:
  - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
  - 2. Operator Location: Wall.
  - 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 ft. or lower.
  - 4. Motor Exposure: Interior.
  - 5. Motor Electrical Characteristics:
    - a. Horsepower: 1 hp.
    - b. Voltage: 115 V ac, single phase, 60 Hz.
  - 6. Emergency Manual Operation: Chain type.
  - 7. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom bar.
    - a. Sensor Edge Bulb Color: Black.
  - 8. Control Station(s): Interior mounted.
  - 9. Other Equipment: Audible and visual signals.
- O. Curtain Accessories: Equip door with smoke seals, automatic-closing device,.
- P. 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.

## 2.4 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.



**2.5 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 A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; 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 E84 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.
- 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.

**2.6 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-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.
  2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

**2.7 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. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

**2.8 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. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. 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. Testing for manually operated doors allows resetting by opening the door without retensioning the counterbalance mechanism. Automatic-closing device is to be designed for activation by the following:
  - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F 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.

## 2.9 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. 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.

## 2.10 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-prewired 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. 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.
- 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. and not more than 12 in./sec., 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 fire-rated doors, activation delays closing.
  1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- 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.
- 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.
- 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.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

## 2.11 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.

## 2.12 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, GENERAL

- 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. 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:
  - 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.
- 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 includes three 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 are to be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.

**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 083323

**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Exterior horizontal rolling steel hangar doors.
2. Basis of design Product: Subject to compliance with requirements, provide by Spec-Dor. or comparable product to be approved by the architect.

**B. Related Requirements:**

1. Section 081113- "Hollow Metal Doors and Frames" for hollow-metal doors and frames.
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
3. Section 08 45 23 "Fiberglass-Sandwich-Panel Assemblies" for framed translucent light panel system.
4. Section 13 34 19 "Metal Building Systems" for pre-engineered metal building system.

**C. Scope of the Work:** The work shall consist of the supply of ONE (1) electrically operated, hangar door system. The finished opening size shall be 160 ft x 28ft high. The motorized door system shall consist of EIGHT (8) bottom rolling door blades on FOUR (4) tracks running the full width of the opening. Each end section shall be independently motorized. The door system be able to render 3/4 the opening on either side or middle.

**D. DESIGN CRITERIA:** Important the quotation is based on design criteria shown

1. Roof deflection, downward: 6 inches
2. Roof deflection, upward: 6 inches
3. Lintel deflection inward 1 inch
4. Door deflection: L/120- of the span
5. Wind load: ASCE 7-16 Cat II exp C
6. Maximum girt spacing 60 inches
7. Exterior siding 3 inch max./ by others
8. Interior siding 1 inch max./ by others

**1.2 REFERENCES**

- A. 1-American Gear Manufacturer's Association(AGMA)
- B. 2-American Institute of Steel Construction (AISC)
- C. 3-M011 - Steel Construction Manual
- D. 5-American Society of Civil Engineers (ASCE)
- E. 6-Minimum Design Loads for Buildings and Other Structures (7-88)
- F. 7-American Society for Testing Materials (ASTM)

- G. 8-Structural Steel A36/A36M
- H. 9-Steel, Carbon, Cold-Rolled Sheet Commercial Quality (A366)
- I. 13-Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality (A569)
- J. 14-High Strength Low Alloy Columbian-Vanadium Steel of Structural Quality (A572 /A 572M)
- K. 15-High Strength Low Alloy Structural Steel with 50KSI (345MPa)Minimum Yield Point to 4 Inch Thick
- L. 16-National Electrical Manufacturers association (NEMA)
- M. 17-Industrial Controls and System (ICS)
- N. 18-National Fire Protection Association (NFPA)
- O. 19-National Electrical Code (NEC)
- P. 20-Official codes, rules and regulations, adopted by the applicable state.
- Q. underwriters Laboratories (UL)
- R. 22-Accessories to meet OSHA regulations. (Toe Guards, Audio and visual warning “Unit in Motion”)

### 1.3 ACTION SUBMITTALS

- A. Product Data: Provide the following.
  - 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 as details of the door's connection to the building.
  - 2. Track layout, girt spacing/locations, weatherstripping details, cladding and flashing details, drive components layout.
  - 3. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 4. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 5. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 6. Show locations of controls, locking devices, and other accessories.
  - 7. Include diagrams for power, signal, and control wiring, include.



**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Manufacture and Installer.
- B. Sample Warranty: For special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Special warranty.
- B. Maintenance Data: Submit operation and maintenance manuals for systems that provide basic data relating to the design, operation, and maintenance of the door and its related systems.
- C. the electrical distribution system
- D. provide basic data relating to the design, operation, and maintenance of
- E. the electrical distribution system
- F. The door manufacturer will submit maintenance manuals to the owners complete with mill test certificates for all structural steel, rails, and bolting materials

**1.6 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.
- B. Hangar door manufacturer shall have at least 10 years of proven, continuous experience in designing and manufacturing hangar doors.

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. The hangar door structure including the bottom wheels and top rollers shall carry a warranty for a period of three years. All electrical components and miscellaneous hardware will carry a two year warranty.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Source Limitations: Obtain hangar doors from single source from single manufacturer.
  - 1. Obtain operators and controls from hangar door manufacturer.

- B. Door design: The door will be designed for maximum thermal efficiency and safety. Door section shall be designed not to exceed the maximum permissible deflection when the full specified wind load is applied on the door's exposed surface. The door's drive system and hardware components shall be designed to operate under the maximum specified wind load with a minimum service factor of 1.5.

## 2.2 DOOR CONSTRUCTION AND FINISHING

- A. Door sections: The door frames shall be fabricated from new structural steel profiles. The design shall comply with AISC 335 standards. The door section shall be designed not to exceed the specified deflection and to withstand 1-1/2 times the nominal windload without exceeding the permissible stresses. The door sections shall be suitable braced with structural members to resist lateral loaded equaling the sections weight. Light cold formed members with tension rod bracings will not be acceptable.
- B. Framing for Man Doors: Manufacturer shall design the door structure with a sub-frame to receive a man door(s) and frame(s). The sub-frames shall be the same thickness as the girts. Interlock switches shall be provided to prevent the hangar door section from operation if the man door is open.
- C. Framing for Windows: If windows are required in the door, the structural framing of the door shall be designed to provide sub-frame for the insertion of windows. The window sub-frames shall be the same depth as the girts.
- D. Door sheeting/insulation: The exterior door surface shall be clad per the drawings. The interior of the door to be covered with liner panel the same as the walls of the hangar the full height of the door. The corner flashings shall follow the door manufacturers details. All siding cladding and flashings, shall be supplied and installed by PEMB. The door will be insulated to the same R value as the exterior walls of the hangar.
- E. Weatherstripping: The interface between each section shall be weatherstripped using one 1/8" thick rubber membrane with metal strip.
- F. Bottom Brush weatherstripping: The door shall be weatherstripped, using one 9 mm thick x 50 mm wide nylon brush and a polyester reinforced urethane rubber as an air barrier. The seal is to be held in place with a 100 mm wide aluminum retainer. The 100 mm wide aluminum retainers shall be supplied with wide slotted holes centered at 228 mm ready to receive removable fasteners for easy field adjustment and long service life.
- G. Towing hooks: The door will be supplied with flush mounted towing hook receptacle situated at each end of the door section.
- H. Shop painting: All metal shall be prepared conforming to SSPC 25. The shop painting of the door sections, top guides, and bottom rails shall consist of 1 coats of zinc rich primer for a total DFT of 3mils.
- I. Building Frame: Coordinate with structural steel building frame provider to provide, perpendicular members at approximately 10'-0" o/c, to receive top door guides. Perpendicular members by building manufacturer. Coordinate with the PEMB that the perpendicular members will be at the proper elevation and within the tolerance specified for the bottom rails.

**2.3 HARDWARE**

- A. Door wheels: The door shall be equipped with completely concealed wheels assuring complete safety. The door wheels shall be machined from alloy steel and heat treated to Brinnell 280 to 320. The wheels shall be double flanged and CNC machined to SPEC-DOR's self centering profile which closely fits the contour of the ground rails. The wheels shall be of sufficient diameter and capacity to carry the wind and door load according to A.S.C.E. Class C regulations. The wheels shall be removable without taking the section from its position on the rail. Wheel diameter shall be not less than 12 inch.
- B. Door wheel bearings: The wheel shall be equipped with sealed cartridge bearings. The size of the bearings shall be calculated based on a service life of not less than 500hrs. Bearing loads shall be calculated based on maximum design windload and the section's dead load with cladding and hardware. Bearing life under with no windload is almost infinite.
- C. Door Wheel Axles: The door axles shall be sized based on 1-1/2 time design windload and the section's dead load with cladding and hardware. The axle material shall conform to AISI 1045 ground and polished. The axle shall be equipped with grease fitting for the wheel bearings.
- D. Sill tracks: The rail size shall be suitable for the design loads or a minimum of 30lbs ASCE rails. The sill tracks shall be complete with leveling bolts. The sill track installation and wedge anchors are by the general contractor and in accordance with the hangar door manufacturer's drawings.
- E. Sill track flashings: Continuous heavy 12 gauge galvanized steel angle flashings are to be provided on both sides of each rail providing a flush surface and level crossing for the aircraft. Faster installation. No concrete grouting and framing.
- F. Rail Drainage pits: Drain pits shall be provided to collect water from the rail gutters and divert it into the building's drainage system. The drain pits shall have removable, chequered plate covers and shall be hot dip Spelter galvanized. The drain pits are factory set into the rails and are equipped with a min 3" dia pipe outlet.
- G. Sill track flashings: Continuous heavy 12 gauge galvanized steel angle flashings are to be provided on both sides of each rail providing a flush surface and level crossing for the aircraft. Faster installation. No concrete grouting and framing.
- H. Provision for Heating: Provide galvanized conduits to be embedded with the bottom of each rail in such a manner the electric heating cables can be installed. Design the system to meet the industry standards for required watt density for track snow melt.
- I. Heating Cables: Provide runs of heating cables complete with control panel and therostatic controls.
- J. Top guides: The top guides shall extend full travel of the sections. The guides shall be fabricated from structural steel members conforming to ASTM A36. The top guides shall be designed to withstand a minimum load of 1.5 kpa., without exceeding the specified deflection or permissible stresses. The guides shall be designed to accommodate downward and upward roof deflection as specified in section 1.2.
- K. Floating top guide rollers: The door shall have steel roller to guide the door and transmit all horizontal loads from the door to the building structure without interference with the operation of the doors. The top rollers should be designed to freely operate within the allowable parameters of

roof deflection and shall not allow the doors to flutter more than 10mm. The rollers shall be fitted with permanently lubricated and sealed, radial bearings and oilite bushings for vertical movement. The rollers shall be easily removable for servicing. Minimum roller diameter shall be not less than 150 mm in diameter.

- L. Bogeys: Bogeys shall be built as a continuous beam designed to transfer all vertical and horizontal loads to the wheels. The bogey shall be shop predrilled, ready to receive the door section(s). The bogeys shall have door wheels accurately shop set, ready for rail mounting.
- M. Drive base: The drive base(s) shall be rigidly factory set onto the bottom bogey to operate without deflection or torsional rotation. The base shall be provided with a machined sliding base plates allowing the drive chain to be easily tensioned by an adjustment screw. The system shall be designed for easy adjustment requiring only wrenched and no lifting of the drive motor. The base design shall be such that removal of the drive wheel will not require the removal of the drive motor and reducer. Slotted holes as a means of adjustment shall not be allowed.
- N. Protective drive cover: Access to the drive gear shall be protected by a steel screen covers. The covers shall have a steel frame with an exterior 1.5mm thick expanded metal screen.
- O. Door stop bumpers: End stops are to be provided to de-accelerate the door sections to a stop, without damage, in the event of a control failure. They are to prevent the possibility of the door sections running off the end of the rails. The end stops shall be designed using calibrated elastomers bumpers based on the maximum mass of the door, traveling at the design speed with the motors off. The bumpers shall be welded to a 10mm steel plate securely anchored in the concrete and welded to the bottom rails. Weldment design shall incorporate the maximum calculated bumper force plus an additional 25% in their design.

## 2.4 DOOR DRIVE GEAR

- A. General layout: Each door section will be independently motorized. The drive gear shall be designed to provide maximum safety to the user and hangar personnel. The drive gear shall consist of a high ratio, helical bevel gear reducer coupled to high efficiency electric motor with electromagnetic brake. The gear reducer shall drive a door wheel through hardened steel sprockets via a steel roller chain. The drive gear shall be designed to operate the door at a speed of not less than 12 inches/sec.
- B. Gear reducers: The gear reducer shall be a high quality helical bevel gear reducer. The all steel gearing and high efficiency design makes this reducer impossible to damage, even during manual towing. The gear reducer will be sized with a service factor of 1.5 according to AGMA standards. The loads shall be calculated based on the design operational windload and the section's dead load with cladding and hardware. The reducer oil shall be AGMA #7.
- C. Motors: The motor shall be a totally enclosed fan cooled unit with IEC design. The motor shall be rated to an IP54 environmental protection. The operating voltage shall be 480V-3 PH-60 HZ, (verify voltage). The motors shall be of sufficient size to drive the door with all applicable load. The motors mounted bellow 457mm off the floor shall be explosion proof type NEMA 7 or CEMA 9. Motors will not be less than 2hp

- D. Brakes: The brake will be a fail safe, spring set, high speed DC solenoid operated disk brake. The brake shall be integral to the motor and shall share a single common shaft with no couplings. The brake shall have a manual release. The brake will be sized to stop the door in 100 mm.
- E. Interlock on Brake Release: An electrical interlock is to be installed on the brake release handle such that the door is disabled if the brake is released.
- F. Roller chains: The roller chains shall be high quality stainless steel roller chain with conforming to ANSI 29.3. The chain shall be designed to handle the reducer's torque with a safety factor of 5.
- G. Sprockets: The sprockets shall be high quality steel sprockets with hardened teeth.

## 2.5 DOOR DRIVE GEAR

- A. General layout: The door will have a control panel mounted on the inner face of the motorized door section. One pushbutton station consisting of an “open” and “closed” pushbutton will be located on the control panel face. Limit switches shall stop the door in the extreme left and extreme right sides of the opening. The controls shall provide for the normal running of the door blades in either direction. The operator shall walk with the door while holding the pushbutton.
- B. Sliding Doors Control panel: The door mounted control panel shall be a NEMA 4/12 waterproof enclosure, of adequate size to contain the necessary controls. The control panel will have an LED power on light, a key switch to prevent unauthorized use, and a main power disconnect switch with locking handle.
- C. Pendant pushbutton station: Provide a pendant pushbutton station suspended near the leading edge and trailing edge of each section. The pendant shall have arrows indicating the desired door direction. The pendant will have protective metal holder to prevent the accidental operation.
- D. End of travel limit switches: The limit switches shall be electric switches. The switches shall be supplied with adjustable mounted brackets and actuating targets. The limit switch shall be NEMA 4 rated or IP56 waterproof.
- E. VSD Variable frequency Drive: “Soft start & Soft stop” All motors shall be controlled by a variable speed drive suitably sized for the drive unit. The unit will be capable of starting the door without harsh mechanical shock as well as de-accelerate the door for precise stopping. The door will slow to 1/3 normal door speed during the last 24 inches of travel in either the fully open or fully closed position. The unit should be sized for operation at full motor load.
- F. Dynamic Braking Module: In conjunction with the VSD, a dynamic braking module shall be provided to have precise control of stopping distances. The module shall ramp the door speed to a stop in a controlled manner without wheel skidding or harsh shock to the structure.
- G. PLC- Programmable logic controller: All controls shall be governed by a programmable logic controller. The controller shall have sufficient I/Os inputs and outputs to perform the door logic as well as a few spares for future expansion.
- H. Warning horn indicating “door in motion”: A 100 db warning horn shall be mounted on the inside face of the motorized door section. The horn shall be activated when the door is in operation.

- I. Visual warning beacon. A flashing beacon shall be mounded on the inside face of the motorized door section. The beacon shall be activated when the door is in operation.
- J. Safety Edge: The leading edge and trailing edge of each motorized door section shall be equipped with an electrical safety edge. When the edge is contacted, the door shall stop and the forward motion disabled. The door can be backed away from the obstruction when the edge is contacted.
- K. Power Line: The power line shall be a multi conductor weather proof duct system. The system shall be supplied complete with junction boxes, strain relief fitting, and trolley arms.

### PART 3 - INSTALLATION AND 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, GENERAL

- A. Install hangar 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 doors controls at the mounting locations indicated per the drawings.

#### 3.3 WIRING

- A. Wire and wiring shall be installed in rigid water tight steel conduit placed inconspicuously on the surface of the door. The conduits should be installed in neat straight runs following the structural features of the door. Wire, and conduits to be supplied and installed by electrical contractor. All material shall be U.L. approved and all wiring shall be installed in strict accordance with all local regulations. Conduits, wire and wiring by electrical contractor.

#### 3.4 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:
  - 1. Test door release, closing, and alarm operations. Test manual operation of door. Reset door-closing mechanism after successful test.

- 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.

### 3.5 STARTUP SERVICE

- A. Engage an 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.

### 3.6 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

### 3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service includes three 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 are to be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hangar doors and to adjust and operate .

END OF SECTION 08 24 16

**SECTION 083613 - SECTIONAL DOORS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Sectional-door assemblies.

**B. Related Requirements:**

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for finish painting of factory-primed steel doors.
3. Section 111200 "Parking Control Equipment" for parking control equipment interlocked to sectional doors.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

**B. Shop Drawings:** For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. 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. Include diagrams for power, signal, and control wiring.

**C. Samples:** For each exposed product and for each color and texture specified, in manufacturer's standard size.**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For Installer.**B. Sample Warranties:** For manufacturer's warranty and finish warranty.



**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sectional doors to include in maintenance manuals.
- B. Manufacturer's warranty.
- C. Finish warranty.

**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.

**1.6 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors 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. Failure of components or operators before reaching required number of operation cycles.
    - c. Faulty operation of hardware.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    - e. Delamination of exterior or interior facing materials.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS, GENERAL**

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
  - 1. Obtain operators and controls from sectional door manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: In accordance with ASTM E330/E330M.
  - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
    - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
    - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
  - 4. Operability under Wind Load: Design sectional doors to remain operable under design wind load, acting inward and outward.

**2.3 SECTIONAL-DOOR ASSEMBLY**

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Overhead Door Corporation.
    - b. Raynor Garage Doors.
    - c. Windsor Door.
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.
- D. U-Value: 0.052 Btu/sq. ft. x h x deg F.
- E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 zinc coating.
  - 1. Door-Section Thickness: 1-3/8 inches.
  - 2. Section Faces:
    - a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.

- b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
  - 1) Steel Sheet Thickness: 0.019-inch nominal coated thickness.
  - 2) Surface: Manufacturer's standard, flat.
- c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
  - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of dimension recommended in writing by manufacturer to comply with performance requirements.
- 3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch nominal coated thickness and welded to door section.
- 4. Intermediate Stiles: Provide intermediate stiles formed from not less than 0.040-inch-thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.
- 5. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.
  - a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
  - b. Hardware Locations: Provide reinforcement for hardware attachment.
- 6. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard insulation of type indicated below:
  - a. Board Insulation: Polystyrene or polyurethane, secured to exterior face sheet.
  - b. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
  - c. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.
- F. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
  - 1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
  - 2. Size: 3 inches wide.
  - 3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

- a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide intermittent jamb brackets attached to track and wall.
  - b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.
- H. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
  - 1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    - b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.
  - 2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
    - a. Roller-Tire Material: Manufacturer's standard.
- I. Locking Device:
  - 1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
  - 2. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.
- J. Counterbalance Mechanism:
  - 1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
  - 2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
    - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
    - b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.
  - 3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.

4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
  5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
  6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- K. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired 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.
  3. Safety: Listed in accordance with 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 ft. or lower.
  4. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
  5. Operator Type: Manufacturer's standard for door requirements.
  6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
    - a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
    - b. Electrical Characteristics:
      - 1) Phase: Single phase Polyphase.
      - 2) Volts: 115 V.
  7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
  8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    - a. Monitored Entrapment Protection: Electric sensor edge on bottom section designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
  9. Control Station: Surface mounted, three-position (open, close, and stop) two-position (open and close) control.
    - a. Operation: Push button.
    - b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
  11. Emergency Operation Disconnect Device: 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.
  12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- L. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. 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.
    - a. 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 substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
  2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install in accordance with UL 325.

**3.3 STARTUP SERVICES**

- 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. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

**3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

**3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

**SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Aluminum-framed entrance and storefront systems.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Aluminum-framed entrance and storefront systems.

**B. Product Data Submittals: For each product.**

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories.

**C. Shop Drawings:**

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:
  - a. Joinery, including concealed welds.
  - b. Anchorage.
  - c. Expansion provisions.
  - d. Glazing.
  - e. Flashing and drainage.
4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. 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.
6. Signed and sealed by the qualified professional engineer responsible for their preparation.

**D. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.**



- E. 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.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.
- B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by a qualified testing agency.
- C. Test and Evaluation Reports:
  - 1. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source Quality-Control Submittals:
  - 1. Source quality-control reports.
- E. Qualification Statements:
  - 1. For Installer and field testing agency.
- F. Sample Warranties: For aluminum-framed entrance and storefront systems.

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Fabricator of products.
  - 2. Entity that employs installers and supervisors who are trained and approved by manufacturer.
  - 3. Authorized representative who is trained and approved by manufacturer.
  - 4. Entity that is certified under the North American Contractor Certification Program (NACC) and that employs installers and supervisors who are trained and approved by manufacturer and who are certified under the Architectural Glass and Metal Technician (AGMT) certification program.

- B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.
- C. Egress Door Inspector Qualifications:
  - 1. Inspector for field quality-control inspections of egress door assemblies to comply with qualifications set forth in NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."
  - 2. Inspector for field quality-control inspections of egress door assemblies to be certified under DHI's certification program as a Fire and Egress Door Assembly Inspector (FDAI) or a Certified Fire and Egress Door Assembly Inspector (CFDAI).
- D. 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.

#### 1.6 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrance and storefront 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, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: 10 Insert number 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 SOURCE LIMITATIONS**

- A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrance and storefront systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrance and storefront systems to 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.
- B. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- C. 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 and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
  - 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.
    - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
  - 3. Cantilever Deflection: Limited to  $2L/175$  at unsupported cantilevers.
- D. 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 Insert number percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. 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..
- F. 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..
  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.
- G. 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 0.41 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
    - b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F 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 0.35 as determined in accordance with NFRC 200.
    - b. Entrance Doors: SHGC of not more than 0.40 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. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested in accordance with ASTM E283.
    - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
  4. Condensation Resistance Factor (CRF):
    - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.

- b. Entrance Doors: CRF of not less than 63 as determined in accordance with AAMA 1503.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, 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.
    - b. Low Exterior Ambient-Air Temperature: 0 deg F.
    - c. Interior Ambient-Air Temperature: 75 deg F.
- I. Structural-Sealant Joints:
  - 1. Designed to carry gravity loads of glazing.
- J. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrance and storefront systems without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant to occur before adhesive failure.
  - 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
  - 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

### 2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. EFCO Corporation.
  - 2. Kawneer Company, Inc.; Arconic Corporation.
  - 3. OldCastle BuildingEnvelope (OBE).
  - 4. Tubelite Inc.
- B. 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: Front.
  - 5. Finish: Clear anodic finish.
  - 6. Fabrication Method: Field-fabricated stick system.

7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  8. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. 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. EFCO Corporation.
  2. Kawneer Company, Inc.; Arconic Corporation.
  3. OldCastle BuildingEnvelope (OBE).
  4. Tubelite Inc.
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-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.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
  2. Door Design: Wide stile; 5-inch nominal width.
  3. Glazing Stops and Gaskets: Square, 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 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article 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 to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
- C. Continuous-Gear Hinges: BHMA A156.26.
- D. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.
- E. Cylinders:
1. As specified in Section 087100 "Door Hardware."
  2. BHMA A156.5, Grade 1.
    - a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" to be furnished by Owner.
- F. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- G. Operating Trim: BHMA A156.6.
- H. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- I. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.
- J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- K. Weather Stripping: Manufacturer's standard replaceable components.
1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
  2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

- M. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

## 2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 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.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch 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 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.
  - 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 shear-block system screw-spline system head-and-sill-receptor system with shear blocks at intermediate horizontal members Insert 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 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**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 OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS**

- 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 079200 "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.
- K. 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.

L. Install glazing as specified in Section 088000 "Glazing."

### 3.3 ERECTION TOLERANCES

- A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:
  1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests.
- B. Tests: Perform the following tests on representative areas of aluminum-framed entrance and storefront systems.
  1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.
    - a. Perform a minimum of two tests in areas as directed by Architect.
  2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
    - a. Perform a minimum of two **<Insert number>** tests in areas as directed by Architect.
  3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and to not evidence water penetration.

- C. Inspection Agency: Engage a qualified inspector to perform inspections.
- D. Inspections:
  - 1. Egress Door Inspections: Inspect each aluminum-framed entrance door equipped with panic hardware, located in an exit enclosure, electrically controlled, and equipped with special locking arrangements, in accordance with NFPA 101, Ch. 7 "Means of Egress," Section "Means of Egress Components," Article "Inspection of Door Openings."
- E. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.5 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 084113

**SECTION 084229.23 - SLIDING AUTOMATIC ENTRANCES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Sliding automatic entrances.

**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. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

**1.3 COORDINATION**

- A. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.
- B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.
- D. System Integration: Integrate sliding automatic entrances with other systems as required for a complete working installation.
  - 1. Provide electrical interface control capability for activation of sliding automatic entrances by security access system on doors with electric locking.
  - 2. Provide electrical interface to deactivate door operators on activation of fire alarm system.
  - 3. Provide electrical interface to allow for remote monitoring of automatic entrance door panel status.

**1.4 ACTION SUBMITTALS**

- A. Product Data: Sliding automatic entrances.
- B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
  2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
- D. Shop Drawings: For sliding automatic entrances.
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. Include diagrams for power, signal, and control wiring.
  4. Indicate locations of activation and safety devices.
  5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- E. Samples for Initial Selection: For units with factory-applied color finishes.
1. Include Samples of hardware and accessories involving color or finish selection.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of automatic entrance.
- C. Sample Warranties: For manufacturer's special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: A manufacturer with Company Certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved 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.
- C. Certified Inspector Qualifications: Certified by AAADM.

**1.8 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances 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. Faulty operation of operators, controls, and hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter 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. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain sliding automatic entrances from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Power-Operated Door Standard: BHMA A156.10.
- 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. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design automatic entrances.
- D. Structural Performance: Automatic entrances to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- F. Operating Temperature Range: Automatic entrances to operate within minus 20 to plus 122 deg F.
- G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
  1. Thermal Transmittance (U-Factor):
    - a. Entrance Doors: U-factor of not more than 0.63 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
  2. Solar Heat-Gain Coefficient (SHGC):
    - a. Entrance Doors: SHGC of not more than 0.35 as determined in accordance with NFRC 200.
  3. Air Leakage:
    - a. Power-Operated Sliding Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
  4. Condensation Resistance Factor (CRF):
    - a. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.
- H. Opening Force:
  1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
  2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.
- I. Entrapment-Prevention Force:
  1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

## 2.3 SLIDING AUTOMATIC ENTRANCES

- A. General: Provide manufacturer's standard automatic entrances, including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.
- B. Sliding, Power-Operated Automatic Entrances Insert drawing designation:
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. ASSA ABLOY Entrance Systems; ASSA ABLOY.



- b. STANLEY Access Technologies LLC; STANLEY Security Solutions, Inc.
  - c. Dormakaba USA Inc.
- 2. Configuration, Biparting-Sliding: Biparting-sliding doors with two sliding leaves sidelites on each side.
  - a. Traffic Pattern: Two way.
  - b. Emergency Breakaway Capability: Sliding leaves only.
  - c. Mounting: Between jambs.
- 3. Operator Features:
  - a. Power opening and closing.
  - b. Drive System: Chain or belt.
  - c. Adjustable opening and closing speeds.
  - d. Adjustable hold-open time between zero and 30 seconds.
  - e. Obstruction recycle.
  - f. On-off/hold-open switch to control electric power to operator.
- 4. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
  - a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.
- 5. Sliding-Door Threshold: Threshold members and bottom-guide-track system with stainless steel, ball-bearing-center roller wheels.
  - a. Configuration, Threshold: Saddle-type threshold across door opening and recessed guide-track system at sidelites.
  - b. Configuration, No Threshold: No threshold across door opening and surface-mounted guide-track system at sidelites.
- 6. Controls: Activation and safety devices in accordance with BHMA standards.
  - a. Activation Device, Motion Sensor: Mounted on each side of door header to detect pedestrians in activating zone and to open door.
  - b. Safety Device, Photoelectric Beams: Two photoelectric beams mounted in sidelite jambs on each side of door to detect pedestrians in presence zone and to prevent door from closing.
  - c. Safety Device, Presence Sensor Under Door Header and Photoelectric Beams: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
  - d. Safety Device, Presence Sensor on Sides of Door Header and Photoelectric Beams: Presence sensor mounted on each side of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.

7. Finish: Finish framing, door(s), and header with Class I, clear anodic finish.

## 2.4 ENTRANCE COMPONENTS

- A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
  1. Nominal Size: 1-3/4 by 4-1/2 inches.
  2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.
- B. Stile and Rail Doors: 1-3/4-inch-thick, glazed doors with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.
  1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
  2. Stile Design: Wide stile, more than 4-inch nominal width.
- C. Headers: Fabricated from minimum 0.125-inch-thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
  1. Mounting: Concealed, with one side of header flush with framing.
  2. Capacity: Capable of supporting doors of up to 175 lb per leaf over spans of up to 14 feet without intermediate supports.
    - a. Provide sag rods for spans exceeding 14 feet.
- D. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Signage: As required by cited BHMA standard.
  1. Application Process: Door manufacturer's standard process.
  2. Provide sign materials with instructions for field application after glazing is installed.

## 2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  1. Extrusions: ASTM B221.
  2. Sheet: ASTM B209.
- B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods in accordance with recommendations in SSPC-SP COM and prepare surfaces in accordance with applicable SSPC standard.

- C. Glazing: As specified in Section 088000 "Glazing."
- D. Sealants and Joint Fillers: As specified in Section 079200 "Joint Sealants."
- E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C1107/C1107M; of consistency suitable for application.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

## 2.6 DOOR OPERATORS AND CONTROLS

- A. General: Provide operators and controls, which include 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 type of occupancy indicated.
- B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.
  - 1. Door Operator Performance: Door operators to open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
  - 2. Electromechanical Operators: Concealed, self-contained, overhead units powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; complying with UL 325; and with manual operation with power off.
- C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by their plastic housings; adjustable to provide detection-field sizes and functions required by BHMA A156.10.
  - 1. Provide capability for switching between bi- and unidirectional detection.
  - 2. For one-way traffic, sensor on egress side to not be active when doors are fully closed.
- D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors remain active at all times.
- E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams to not be active when doors are fully closed.
- F. 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.

## 2.7 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.

- B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door to be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.
  - 1. Include one adjustable detent device mounted at the top of each breakaway panel to control breakaway force.
    - a. Panel Closer: Factory-installed concealed hydraulic door closer.
    - b. Limit Arms: Limit swing to 90 degrees, spring loaded with adjustable friction damping.
- C. Access-Control Locking: Electrically controlled device mounted in header that automatically locks sliding door in closed position, preventing door panels from sliding manually. Provide fail- safe operation if power fails.
  - 1. Power Interruption: Lock to be disengaged, allowing doors to slide manually.
  - 2. Means of Egress: Vertical rod exit device.
  - 3. Include locking devices for sidelites to prevent manual breakout.
- D. Weather Stripping: Replaceable components.
  - 1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

## 2.8 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
  - 1. Form aluminum shapes before finishing.
  - 2. 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.
  - 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.
    - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
    - b. Reinforce members as required to receive fastener threads.
  - 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
  - 1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.

2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
  3. Form profiles that are sharp, straight, and free of defects or deformations.
  4. Provide components with concealed fasteners and anchor and connection devices.
  5. Fabricate components with accurately fitted joints, with ends coped or mitered to produce hairline joints free of burrs and distortion.
  6. Fabricate exterior components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
  7. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, in accordance with NGA's "GANA Glazing Manual."
- F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors.
- G. Controls:
1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
  2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
    - a. Top Beam: 48 inches.
    - b. Bottom Beam: 24 inches.

## 2.9 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a 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 the range of approved Samples and are assembled or installed to minimize contrast.

**2.10 ALUMINUM FINISHES**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. General: Install automatic entrances in accordance with manufacturer's written instructions and cited BHMA A156.10 for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.
  - 1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
  - 2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
  - 3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
  - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
  - 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
  - 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
  - 4. Level recesses for recessed thresholds using nonshrink grout.
- C. Door Operators: Connect door operators to electrical power distribution system.
- D. Access-Control Devices: Connect access-control devices to access-control system, as specified in Section 281300 "Access Control Software and Database Management."
- E. Controls: Install and adjust activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect

control wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- F. Glazing: Install glazing as specified in Section 088000 "Glazing."
- G. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants" to provide weathertight installation.
  - 1. Set thresholds, bottom-guide-track system, framing members and flashings in full sealant bed.
  - 2. Seal perimeter of framing members with sealant.
- H. Signage: Apply signage on both sides of each door, as required by cited BHMA standard for direction of pedestrian travel.
- I. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

### 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 entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Automatic entrances will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.4 ADJUSTING

- A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
  - 1. Adjust exterior doors for tight closure.
- B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- C. Occupancy Adjustments: 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 CLEANING**

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
  - 1. Comply with requirements in Section 088000 "Glazing" for cleaning and maintaining glass.

**3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229.23



**SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:

1. Wall assemblies.

**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 aluminum components of panel assemblies.

- B. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

- C. Samples: In manufacturer's standard size.

1. For each type of fiberglass-sandwich panel.
2. For each type of exposed finish for framing members.

- D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:

1. Joinery.
2. Anchorage.
3. Expansion provisions.
4. Fiberglass-sandwich panels.
5. Flashing and drainage.

- E. Delegated Design Submittals: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified Installer manufacturer.
- B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.
- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For panel assemblies to include in maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04 or ICC-ES AC177.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

**1.7 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies 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. Deterioration of metals and other materials beyond normal weathering.
    - c. Water leakage.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.
  - 1. Defects include, but are not limited to, the following:
    - a. Fiberbloom.
    - b. Delamination of coating, if any, from exterior face sheet.
    - c. Color change exceeding requirements.
    - d. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
  1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
  2. Warranty Period: 20 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 014000 "Quality Requirements," to design fiberglass-sandwich-panel assemblies.
- B. Structural Loads: As indicated on Drawings.
- C. Deflection Limits:
  1. Vertical Panel Assemblies: Limited to 1/120 of clear span for each assembly component.
  2. Overhead Panel Assemblies: Limited to 1/180 of clear span for each assembly component.
- D. Structural-Test Performance: Provide panel assemblies tested in accordance with ASTM E330, as follows:
  1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and 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.
- E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- F. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested in accordance with AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
  1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water that is controlled by flashing

and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.

- G. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. 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, ambient; 180 deg F, material surfaces.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas to have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
  - 2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas to have a SHGC of no greater than 0.6 as determined in accordance with NFRC 200.
  - 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined in accordance with ASTM E283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft..

## 2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

- A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kalwall Corporation.
    - b. Major Industries, Inc.

## 2.3 FIBERGLASS-SANDWICH PANELS

- A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.
- B. Panel Thickness: 4 inches.
- C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.
  - 1. Extruded Aluminum: ASTM B221, in alloy and temper recommended in writing by manufacturer.
  - 2. I-Beam Construction: Thermally broken, extruded aluminum.
  - 3. Grid Pattern: Inline rectangle, nominal 12 by 24 inches.
- D. Exterior Face Sheet:
  - 1. Thickness: 0.070 inch.
  - 2. Color: As selected by Architect from manufacturer's full range.

3. Protective Weathering Surface: Manufacturer's standard.

E. Interior Face Sheet:

1. Thickness: 0.045 inch.
2. Color: As selected by Architect from manufacturer's full range.

F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.

G. Panel Strength:

1. Maximum Panel Deflection: 3-1/2 inches when a 4-by-12-foot panel is tested in accordance with ASTM E72 at 34 lbf/sq. ft., with a maximum 0.090-inch set deflection after five minutes.
2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch-diameter disk in accordance with ASTM E661.

H. Panel Performance:

1. Self-Ignition Temperature: 650 deg F or more in accordance with ASTM D1929.
2. Smoke-Developed Index: 450 or less in accordance with ASTM E84, or 75 or less in accordance with ASTM D2843.
3. Combustibility Classification: Class CC1 based on testing in accordance with ASTM D635.
4. Interior Finish Classification: Class A based on testing in accordance with ASTM E84.
5. Color Change: Not more than 3.0 units Delta E, when measured in accordance with ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.
  - a. Outdoor Weathering Conditions: Sixty months in southern Florida.
6. Impact Resistance: No fracture or tear at impact of 60 ft. x lbf by a 3-1/4-inch-diameter, 5-lb freefalling ball in accordance with UL 972 test procedure.
7. Haze Factor: Greater than 90 percent when tested in accordance with ASTM D1003.

## 2.4 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken, extruded aluminum.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
4. Structural Profiles: ASTM B308/B308M.

- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
  - 1. At closures, retaining caps, or battens, use ASTM A193/A193M, 300 series stainless steel screws.
  - 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.
- G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- H. Exposed Flashing and Closures: Aluminum sheet not less than 0.040 inch thick, finished to match framing.
- I. Framing Gaskets: Manufacturer's standard.
- J. Frame-System Sealants: As recommended in writing by manufacturer.
- K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.5 FABRICATION

- A. Frame System Fabrication:
  - 1. Fabricate components that, when assembled, have the following characteristics:
    - a. Profiles that are sharp, straight, and free of defects or deformations.
    - b. Accurately fitted joints with ends coped or mitered.
    - c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.
  - 2. Fabricate sill closures with weep holes and for installation as continuous component.
  - 3. Reinforce components as required to receive fastener threads.
- B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
  - a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.
2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
  1. Color: As selected by Architect from full range of industry colors and color densities.

## 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

- A. General: Comply with manufacturer's written instructions.
  1. Do not install damaged components.
  2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
  3. Rigidly secure nonmovement joints.
  4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
  5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install components plumb and true in alignment with established lines and elevations.

- D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.
- E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
  - 1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
  - 2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies to be tested in accordance with AAMA 501.2 and to not show evidence of water penetration.
  - 2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas to be tested in accordance with ASTM E1105.
    - a. Test Procedures: Test under uniform and cyclic static-air pressure.
    - b. Static-Air-Pressure Difference: 0.67 times the pressure specified for laboratory testing according to ASTM E331.
    - c. Water Penetration: None.
- B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

END OF SECTION 084523



**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 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes:

- 1. Mechanical door hardware for the following:
    - a. Swinging doors.
  - 2. Cylinders for door hardware specified in other Sections.
  - 3. Electrified door hardware.

- B. Related Sections:

- 1. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies.
  - 2. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
  - 3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
  - 4. Section 081416 "Flush Wood Doors" for provided as part of labeled fire-rated assemblies.
  - 5. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Other Action Submittals:

- 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
    - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door

hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
  - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
  - d. Content: Include the following information:
    - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
    - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
    - 4) Fastenings and other pertinent information.
    - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
    - 6) Mounting locations for door hardware.
    - 7) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Architectural Hardware Consultant.
- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

#### 1.6 QUALITY ASSURANCE

- A. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
  1. For door hardware, an Architectural Hardware Consultant (AHC).

- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
  - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- E. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
  - 2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
  - 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- G. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
  - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  - 2. Preliminary key system schematic diagram.
  - 3. Requirements for key control system.
  - 4. Requirements for access control.
  - 5. Address for delivery of keys.
- H. 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. Inspect and discuss preparatory work performed by other trades.
3. Review sequence of operation for each type of electrified door hardware.
4. Review required testing, inspecting, and certifying procedures.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

#### 1.8 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system, as applicable.
- C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

- a. Exit Devices: Two years from date of Substantial Completion.
- b. Manual Closers: 10 years from date of Substantial Completion.

#### 1.10 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

#### 1.11 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using 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 Part 3 "Door Hardware Schedule" Article.
  - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

#### 1.12 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Baldwin Hardware Corporation.
    - b. Bommer Industries, Inc.
    - c. IVES Hardware; an Allegion company.

**1.13 CONTINUOUS HINGES**

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bommer Industries, Inc.
    - b. IVES Hardware; an Allegion company.
    - c. Select Products Limited.

**1.14 MECHANICAL LOCKS AND LATCHES**

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
  - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- D. Lock Trim:
  - 1. Operating Device: Lever with escutcheons (roses). Lever style to match existing locks.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following.
    - a. Schlage Commercial Lock Division; an Allegion company. No substitutions.
- G. Mortise Locks: BHMA A156.13; Grade 1; stamped steel case with steel or brass parts; Series 1000.
  - 1. Manufacturers: Subject to compliance with requirements provide products by the following.

- a. Schlage Commercial Lock Division; an Allegion company. No substitutions.
2. Additional Requirements:
  - a. Where specified, provide locks with indicator. Indicator window shall measure a minimum 2 inch x 1/2 inch with 180 degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
  - b. Provide trim to match existing locksets.
  - c. Tornado Applications: Provide multipoint lockset assembly UL approved to FEMA 361 guidelines. Must be used with tested and approved door and frame system.

#### 1.15 EXIT DEVICES AND AUXILIARY ITEMS

##### A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by the following.
  - a. Von Duprin; an Allegion company. No substitutions.
2. Additional Requirements:
  - a. Exit devices shall incorporate a fluid damper or other device that eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width, but not the full length of the exit device rail. End-cap will have two-point attachment to door.
  - b. Removable mullions shall be a 2-inch by 3-inch steel tube. All mullions shall be of a type that can be removed by use of a keyed cylinder, which is self-locking when reinstalled. All mullions to be powder coated, provide custom color mullions where specified to match door/frame.
  - c. Non-fire-rated exit devices shall have cylinder dogging, provide special dogging (SD) in device head where specified.
  - d. All exit devices into educational spaces to have classroom security (-2SI) function allowing trim to be locked/unlocked from inside.
  - e. Tornado Applications: Provide assembly UL approved to FEMA 361 guidelines for outswing single or pair doors. Must be used with tested and approved door and frame system.
  - f. Provide electrical options as scheduled.

#### 1.16 LOCK CYLINDERS

##### A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturers: Subject to compliance with requirements provide products by the following.
  - a. Schlage Commercial Lock Division; an Allegion company unless another key system exists.

- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are removable (where specified); face finished to match lockset.

**1.17 KEYING**

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

- 1. Existing System:

- a. Master key or grand master key locks to Owner's existing system. Exterior doors shall have Schlage Primus cylinders, interior cylinders shall be Everest restricted. Hardware Supplier to verify proper key system.
    - 1) All exterior doors to be supplied with temporary cores.

- B. Keys: Brass.

- 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

- a. Notation: "DO NOT DUPLICATE."

- 2. Quantity: In addition to one extra key blank for each lock, provide the following:

- a. Cylinder Change Keys: Three.
  - b. Master Keys: Five.

**1.18 OPERATING TRIM**

- A. Operating Trim: BHMA A156.6; brass, unless otherwise indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. IVES Hardware; an Allegion company.
  - b. Rockwood Manufacturing Company.
  - c. Trimco.

**1.19 ACCESSORIES FOR PAIRS OF DOORS**

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

- B. Astragals: BHMA A156.22.



**1.20 SURFACE CLOSERS**

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
1. Manufacturers: Subject to compliance with requirements provide products by the following.
    - a. LCN Closers; an Allegion company. No substitutions.
  2. Additional Requirements:
    - a. All Closers UL Certified to be in compliance with UBC 7.2 and UL 10C.
    - b. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
    - c. Closers shall have certification by an independent testing laboratory of 10,000,000 cycles without failure.
    - d. Closers with pressure relief valves will not be acceptable.
    - e. Through bolt all closer units, using sex bolt fasteners.
    - f. Closer cylinders, arms, adapter plates, and metal covers shall have a powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or shall have special rust inhibitor (SRI).
    - g. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

**1.21 MECHANICAL STOPS AND HOLDERS**

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. IVES Hardware; an Allegion company.
    - b. Rockwood Manufacturing Company.
    - c. Trimco.

**1.22 ELECTROMAGNETIC STOPS AND HOLDERS**

- A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. LCN Closers; an Allegion company.

## 1.23 OVERHEAD STOPS AND HOLDERS

### A. Overhead Stops and Holders: BHMA A156.8.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Architectural Builders Hardware Mfg., Inc.
  - b. Glynn-Johnson; an Allegion company.
  - c. Rockwood Manufacturing Company.

## 1.24 THRESHOLDS

### A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

- 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - a. National Guard Products.
  - b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
  - c. Zero Companies.

## 1.25 METAL PROTECTIVE TRIM UNITS

### A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

- 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - a. IVES Hardware; an Allegion company.
  - b. Rockwood Manufacturing Company.
  - c. Trimco.

## 1.26 AUXILIARY DOOR HARDWARE

### A. Auxiliary Hardware: BHMA A156.16.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. IVES Hardware; an Allegion company.
  - b. Hager Companies.
  - c. Rockwood Manufacturing Company.
  - d. Trimco.

**1.27 FABRICATION**

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Fire-Rated Applications:
    - a. Wood or Machine Screws: For the following:
      - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      - 2) Strike plates to frames.
      - 3) Closers to doors and frames.
    - b. Steel Through Bolts: For the following unless door blocking is provided:
      - 1) Surface hinges to doors.
      - 2) Closers to doors and frames.
      - 3) Surface-mounted exit devices.
  - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
  - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
  - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

**1.28 FINISHES**

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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.

## PART 2 - EXECUTION

### 2.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 2.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

### 2.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's 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. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards. Self-tapping screws are not an acceptable means of installation.

- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  - 1. Replace construction cores with permanent cores as indicated in keying schedule or directed by Owner.
  - 2. Furnish permanent high security cores to Owner for installation.
- E. Thresholds: Set thresholds for doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Where gasketing is soffit mounted install prior to any soffit mounted hardware to ensure continuous perimeter seal.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold or floor when door is closed.

## 2.4 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.
  - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

## 2.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

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**2.6 DEMONSTRATION**

- A. Contractor to instruct owner's personnel to adjust, operate, and maintain door hardware and door hardware finishes.

**2.7 DOOR HARDWARE SCHEDULE**

- A. The hardware sets listed below 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.

HARDWARE SET: 01

DOOR NUMBER:

126-C

126-D

126-E

127-A

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER                | FINISH | MFR |
|-----|----|---------------------|-------------------------------|--------|-----|
| 4   | EA | HINGE               | 5BB1HW NRP                    | 630    | IVE |
| 1   | EA | POWER TRANSFER      | EPT10 CON                     | 689    | VON |
| 1   | EA | ELEC PANIC HARDWARE | RX-LC-QEL-99-NL-CON 24 VDC    | 626    | VON |
| 1   | EA | RIM HOUSING         | 20-079                        | 626    | SCH |
| 1   | EA | FSIC PERM. CORE     | 23-030 EV29 T                 | 626    | SCH |
| 1   | EA | FSIC CONSTR. CORE   | 23-030 ICX                    | ORG    | SCH |
| 1   | EA | SURFACE CLOSER      | 4040XP SCUSH                  | 689    | LCN |
| 1   | EA | KICK PLATE          | 8400 10" X 2" LDW B-CS        | 630    | IVE |
| 1   | EA | RAIN DRIP           | 142AA                         | AA     | ZER |
| 1   | EA | DOOR SWEEP          | 8198AA                        | AA     | ZER |
| 1   | EA | THRESHOLD           | 103A-223                      | A      | ZER |
| 2   | EA | WIRE HARNESS        | CON X LENGTH REQ'D            |        | SCH |
| 1   | EA | DOOR CONTACT        | 7764                          | 628    | SCE |
| 1   | EA | POWER SUPPLY        | BY SECURITY SYSTEM INTEGRATOR |        | B/O |
| 1   | EA | DOOR CALL STATION   | BY SECURITY SYSTEM INTEGRATOR |        |     |
| 1   | EA | CARD READER         | BY SECURITY SYSTEM INTEGRATOR |        |     |
| 1   | EA | WEATHERSTRIP        | BY DOOR/FRAME MANUFACTURER    |        | B/O |
| 1   | EA | WIRING DIAGRAM      | BY SECURITY SYSTEM INTEGRATOR |        |     |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS VIA VALID CARD READ. PANIC MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. OUTSIDE ADA ACTUATOR ONLY OPERABLE WHEN DOOR IS DOGGED OR AFTER VALID CARD READ, INSIDE ACTUATOR ALWAYS OPERABLE. ALWAYS FREE EGRESS.

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HARDWARE SET: 02

DOOR NUMBER:

114-B

121-A

EACH TO HAVE:

| QTY |    | DESCRIPTION           | CATALOG NUMBER                   | FINISH | MFR |
|-----|----|-----------------------|----------------------------------|--------|-----|
| 1   | EA | CONTINUOUS HINGE      | BY SPECIAL-LITE                  |        | SPE |
| 1   | EA | POWER TRANSFER        | EPT10 CON                        | 689    | VON |
| 1   | EA | ELEC PANIC HARDWARE   | RX-LC-QEL-99-EO-CON 24 VDC       | 626    | VON |
| 1   | EA | 90 DEG OFFSET PULL    | 8190HD 10"                       | 630    | IVE |
| 1   | EA | SURFACE CLOSER        | 4040XP EDA                       | 689    | LCN |
| 1   | EA | PA MOUNTING PLATE     | 4040XP-18PA (IF REQ'D)           | 689    | LCN |
| 1   | EA | BLADE STOP SPACER     | 4040XP-61 (IF REQ'D)             | 689    | LCN |
| 1   | EA | FLOOR STOP            | FS444                            | 626    | IVE |
| 1   | EA | DOOR SWEEP            | 8198AA                           | AA     | ZER |
| 1   | EA | ADJUSTABLE DOOR SWEEP | BY SPECIAL-LITE                  |        | SPE |
| 1   | EA | THRESHOLD             | 103A-223                         | A      | ZER |
| 2   | EA | WIRE HARNESS          | CON X LENGTH REQ'D               |        | SCH |
| 1   | EA | DOOR CONTACT          | 7764                             | 628    | SCE |
| 1   | EA | POWER SUPPLY          | BY SECURITY SYSTEM<br>INTEGRATOR |        | B/O |
| 1   | EA | CARD READER           | BY SECURITY SYSTEM<br>INTEGRATOR |        |     |
| 1   | EA | WEATHERSTRIP          | BY DOOR/FRAME<br>MANUFACTURER    |        | B/O |
| 1   | EA | WIRING DIAGRAM        | BY SECURITY SYSTEM<br>INTEGRATOR |        |     |

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PANIC MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY. WHEN LOCKED, ENTRY BY CARD READER. ALWAYS FREE EGRESS.

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HARDWARE SET: 03

DOOR NUMBER:

126-A                      126-B                      126-G

EACH TO HAVE:

| QTY |     | DESCRIPTION    | CATALOG NUMBER                   | FINISH | MFR |
|-----|-----|----------------|----------------------------------|--------|-----|
| 4   | EA  | HINGE          | 5BB1HW NRP                       | 630    | IVE |
| 1   | EA  | PANIC HARDWARE | 99-EO                            | 626    | VON |
| 1   | EA  | ACCESSORY      | LESS DOGGING PLATE               | 626    | VON |
| 1   | EA  | SURFACE CLOSER | 4040XP SCUSH                     | 689    | LCN |
| 1   | EA  | KICK PLATE     | 8400 10" X 2" LDW B-CS           | 630    | IVE |
| 1   | EA  | RAIN DRIP      | 142AA                            | AA     | ZER |
| 1   | SET | GASKETING      | 429AA-S                          | AA     | ZER |
| 1   | EA  | DOOR SWEEP     | 8197AA                           | AA     | ZER |
| 1   | EA  | THRESHOLD      | 103A-223                         | A      | ZER |
| 1   | EA  | DOOR CONTACT   | 679-05 HM/WD AS REQ'D            | BLK    | SCE |
| 1   | EA  | MOTION SENSOR  | SCANII 12/24 VDC                 | WHT    | SCE |
| 1   | EA  | WIRING DIAGRAM | BY SECURITY SYSTEM<br>INTEGRATOR |        |     |

OPERATION: DOOR CONTACT MONITORS DOOR POSITION.

NOTE: INSTALL WEATHERSTRIP AT FRAME HEAD FIRST, THEN INSTALL CLOSER PA BRACKET ON WEATHERSTRIP.

HARDWARE SET: 04

DOOR NUMBER:

118-A

EACH TO HAVE:

| QTY |    | DESCRIPTION        | CATALOG NUMBER         | FINISH | MFR |
|-----|----|--------------------|------------------------|--------|-----|
| 4   | EA | HINGE              | 5BB1HW                 | 652    | IVE |
| 1   | EA | FIRE EXIT HARDWARE | 99-L-F-06              | 626    | VON |
| 1   | EA | RIM HOUSING        | 20-079                 | 626    | SCH |
| 1   | EA | FSIC PERM. CORE    | 23-030 EV29 T          | 626    | SCH |
| 1   | EA | SURFACE CLOSER     | 4040XP SCUSH           | 689    | LCN |
| 1   | EA | KICK PLATE         | 8400 10" X 2" LDW B-CS | 630    | IVE |
| 1   | EA | GASKETING          | 488SBK PSA             | BK     | ZER |
| 1   | EA | DOOR SWEEP         | 39A                    | A      | ZER |
| 1   | EA | THRESHOLD          | 655A-223               | A      | ZER |



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HARDWARE SET: 05

DOOR NUMBER:

104-B

204-A

EACH TO HAVE:

| QTY |    | DESCRIPTION         | CATALOG NUMBER                   | FINISH | MFR |
|-----|----|---------------------|----------------------------------|--------|-----|
| 4   | EA | HINGE               | 5BB1HW                           | 652    | IVE |
| 1   | EA | POWER TRANSFER      | EPT10 CON                        | 689    | VON |
| 1   | EA | ELEC PANIC HARDWARE | RX-LC-QEL-99-L-NL-06-CON 24 VDC  | 626    | VON |
| 1   | EA | RIM HOUSING         | 20-079                           | 626    | SCH |
| 1   | EA | FSIC PERM. CORE     | 23-030 EV29 T                    | 626    | SCH |
| 1   | EA | SURFACE CLOSER      | 4040XP EDA                       | 689    | LCN |
| 1   | EA | KICK PLATE          | 8400 10" X 2" LDW B-CS           | 630    | IVE |
| 1   | EA | WALL STOP           | WS406/407CCV                     | 630    | IVE |
| 1   | EA | GASKETING           | 488SBK PSA<br>(AT RATED DOORS)   | BK     | ZER |
| 1   | EA | DOOR CONTACT        | 679-05 HM/WD AS REQ'D            | BLK    | SCE |
| 1   | EA | POWER SUPPLY        | BY SECURITY SYSTEM<br>INTEGRATOR |        | B/O |
| 1   | EA | CARD READER         | BY SECURITY SYSTEM<br>INTEGRATOR |        |     |

HARDWARE SET: 06

DOOR NUMBER:

115-A

119-A

209-A

222-A

223-A

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|----------------|--------|-----|
| 4   | EA | HINGE          | 5BB1HW         | 652    | IVE |
| 1   | EA | STOREROOM LOCK | ND80P6D RHO    | 626    | SCH |
| 1   | EA | WALL STOP      | WS406/407CCV   | 630    | IVE |
| 3   | EA | SILENCER       | SR64           | GRY    | IVE |

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HARDWARE SET: 07

DOOR NUMBER:

111-A 117-A

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER                  | FINISH | MFR |
|-----|----|-------------------|---------------------------------|--------|-----|
| 4   | EA | HINGE             | 5BB1HW                          | 652    | IVE |
| 1   | EA | POWER TRANSFER    | EPT10 CON                       | 689    | VON |
| 1   | EA | EU STOREROOM LOCK | ND80P6DEU RHO RX CON 12V/24V DC | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4040XP RW/PA                    | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS          | 630    | IVE |
| 1   | EA | WALL STOP         | WS406/407CCV                    | 630    | IVE |
| 1   | EA | GASKETING         | 488SBK PSA                      | BK     | ZER |
| 1   | EA | DOOR SWEEP        | 39A                             | A      | ZER |
| 1   | EA | THRESHOLD         | 655A-223                        | A      | ZER |
| 1   | EA | DOOR CONTACT      | 679-05 HM/WD AS REQ'D           | BLK    | SCE |
| 1   | EA | POWER SUPPLY      | BY SECURITY SYSTEM INTEGRATOR   |        | B/O |
| 1   | EA | CARD READER       | BY SECURITY SYSTEM INTEGRATOR   |        |     |

HARDWARE SET: 08

DOOR NUMBER:

116-A 221-A

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER                  | FINISH | MFR |
|-----|----|-------------------|---------------------------------|--------|-----|
| 4   | EA | HINGE             | 5BB1HW                          | 652    | IVE |
| 1   | EA | POWER TRANSFER    | EPT10 CON                       | 689    | VON |
| 1   | EA | EU STOREROOM LOCK | ND80P6DEU RHO RX CON 12V/24V DC | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4040XP RW/PA                    | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS          | 630    | IVE |
| 1   | EA | WALL STOP         | WS406/407CCV                    | 630    | IVE |
| 1   | EA | GASKETING         | 488SBK PSA<br>(AT RATED DOORS)  | BK     | ZER |
| 1   | EA | DOOR CONTACT      | 679-05 HM/WD AS REQ'D           | BLK    | SCE |
| 1   | EA | POWER SUPPLY      | BY SECURITY SYSTEM INTEGRATOR   |        | B/O |
| 1   | EA | CARD READER       | BY SECURITY SYSTEM INTEGRATOR   |        |     |

**DOOR HARDWARE****SECTION 08 71 00**

LXT Eastside Development

Project #47732472

Permit Set 09/29/22

HARDWARE SET: 09

DOOR NUMBER:

215-A

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER                 | FINISH | MFR |
|-----|----|----------------|--------------------------------|--------|-----|
| 4   | EA | HINGE          | 5BB1HW                         | 652    | IVE |
| 1   | EA | STOREROOM LOCK | ND80P6D RHO                    | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4040XP RW/PA                   | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS         | 630    | IVE |
| 1   | EA | WALL STOP      | WS406/407CCV                   | 630    | IVE |
| 1   | EA | GASKETING      | 488SBK PSA<br>(AT RATED DOORS) | BK     | ZER |
| 3   | EA | SILENCER       | SR64                           | GRY    | IVE |

HARDWARE SET: 10

DOOR NUMBER:

220-A

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER             | FINISH | MFR |
|-----|----|-------------------|----------------------------|--------|-----|
| 4   | EA | HINGE             | 5BB1HW                     | 652    | IVE |
| 1   | EA | OFFICE/ENTRY LOCK | L9050J 06A 09-544 L283-711 | 626    | SCH |
| 1   | EA | FSIC PERM. CORE   | 23-030 EV29 T              | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4040XP HCUSH               | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS     | 630    | IVE |
| 1   | EA | GASKETING         | 488SBK PSA                 | BK     | ZER |

HARDWARE SET: 11

DOOR NUMBER:

127-F

216-A

EACH TO HAVE:

| QTY |    | DESCRIPTION    | CATALOG NUMBER         | FINISH | MFR |
|-----|----|----------------|------------------------|--------|-----|
| 4   | EA | HINGE          | 5BB1HW                 | 652    | IVE |
| 1   | EA | CLASSROOM LOCK | ND70P6D RHO            | 626    | SCH |
| 1   | EA | SURFACE CLOSER | 4040XP                 | 689    | LCN |
| 1   | EA | KICK PLATE     | 8400 10" X 2" LDW B-CS | 630    | IVE |
| 1   | EA | WALL STOP      | WS406/407CCV           | 630    | IVE |
| 1   | EA | GASKETING      | 488SBK PSA             | BK     | ZER |

**DOOR HARDWARE****SECTION 08 71 00**

LXT Eastside Development

Project #47732472

Permit Set 09/29/22

HARDWARE SET: 12

DOOR NUMBER:

121-B

EACH TO HAVE:

| QTY |    | DESCRIPTION       | CATALOG NUMBER         | FINISH | MFR |
|-----|----|-------------------|------------------------|--------|-----|
| 4   | EA | HINGE             | 5BB1HW                 | 652    | IVE |
| 1   | EA | DBL CYL COMM LOCK | ND72P6 RHO XN12-002    | 626    | SCH |
| 1   | EA | SURFACE CLOSER    | 4040XP SCUSH           | 689    | LCN |
| 1   | EA | KICK PLATE        | 8400 10" X 2" LDW B-CS | 630    | IVE |
| 1   | EA | GASKETING         | 488SBK PSA             | BK     | ZER |
| 1   | EA | DOOR SWEEP        | 39A                    | A      | ZER |
| 1   | EA | THRESHOLD         | 655A-223               | A      | ZER |

HARDWARE SET: 13

DOOR NUMBER:

113-A

114-A

125-A

205-A

211-A

212-A

219-A

EACH TO HAVE:

| QTY |    | DESCRIPTION   | CATALOG NUMBER | FINISH | MFR |
|-----|----|---------------|----------------|--------|-----|
| 4   | EA | HINGE         | 5BB1HW         | 652    | IVE |
| 1   | EA | ENTRANCE LOCK | ND53P6D RHO    | 626    | SCH |
| 1   | EA | WALL STOP     | WS406/407CCV   | 630    | IVE |
| 3   | EA | SILENCER      | SR64           | GRY    | IVE |

NOTE: PROVIDE FLOOR STOP IN LIEU OF WALL STOP WHERE REQUIRED.

HARDWARE SET: 14

DOOR NUMBER:

123-A

208-A

210-A

EACH TO HAVE:

| QTY |    | DESCRIPTION          | CATALOG NUMBER               | FINISH | MFR |
|-----|----|----------------------|------------------------------|--------|-----|
| 4   | EA | HINGE                | 5BB1HW                       | 652    | IVE |
| 1   | EA | OFFICE W/SIM RETRACT | L9056J 06A L583-363 L283-722 | 626    | SCH |
| 1   | EA | FSIC PERM. CORE      | 23-030 EV29 T                | 626    | SCH |
| 1   | EA | SURFACE CLOSER       | 4040XP RW/PA                 | 689    | LCN |
| 1   | EA | KICK PLATE           | 8400 10" X 2" LDW B-CS       | 630    | IVE |
| 1   | EA | WALL STOP            | WS406/407CCV                 | 630    | IVE |
| 1   | EA | GASKETING            | 488SBK PSA                   | BK     | ZER |

**DOOR HARDWARE****SECTION 08 71 00**

LXT Eastside Development

Project #47732472

Permit Set 09/29/22

HARDWARE SET: 15

DOOR NUMBER:

105-A 106-A

EACH TO HAVE:

| QTY |    | DESCRIPTION        | CATALOG NUMBER         | FINISH | MFR |
|-----|----|--------------------|------------------------|--------|-----|
| 1   | EA | CONT. HINGE        | 224XY                  | 628    | IVE |
| 1   | EA | CLASSROOM SEC W/DB | L9457J 06A             | 626    | SCH |
| 2   | EA | FSIC PERM. CORE    | 23-030 EV29 T          | 626    | SCH |
| 1   | EA | SURFACE CLOSER     | 4040XP RW/PA           | 689    | LCN |
| 1   | EA | KICK PLATE         | 8400 10" X 2" LDW B-CS | 630    | IVE |
| 1   | EA | WALL STOP          | WS406/407CCV           | 630    | IVE |
| 3   | EA | SILENCER           | SR64                   | GRY    | IVE |

HARDWARE SET: 16

DOOR NUMBER:

217-A

EACH TO HAVE:

| QTY |    | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|-------------|----------------|--------|-----|
| 4   | EA | HINGE       | 5BB1HW         | 652    | IVE |
| 1   | EA | PASSAGE SET | ND10S RHO      | 626    | SCH |
| 1   | EA | WALL STOP   | WS406/407CCV   | 630    | IVE |
| 3   | EA | SILENCER    | SR64           | GRY    | IVE |

HARDWARE SET: 17

DOOR NUMBER:

100-A 100-B 110-A 110-B

EACH TO HAVE:

| QTY |    | DESCRIPTION          | CATALOG NUMBER       | FINISH | MFR |
|-----|----|----------------------|----------------------|--------|-----|
| 1   | EA | MORTISE HOUSING      | 26-064               | 626    | SCH |
| 1   | EA | FSIC PERM. CORE      | 23-030 EV29 T        | 626    | SCH |
| 1   | EA | LOCAL CONTROL SWITCH | BY DOOR MANUFACTURER |        |     |

NOTE: BALANCE OF HARDWARE BY DOOR SYSTEM MANUFACTURER. VERIFY CYLINDER TYPE/QUANTITY REQUIRED WITH DOOR MANUFACTURER.

HARDWARE SET: 18

DOOR NUMBER:

121-C 126-F 127-B 127-C 127-D 127-E

EACH TO HAVE:

| QTY |  | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|--|-------------|----------------|--------|-----|
|-----|--|-------------|----------------|--------|-----|

NOTE: ALL HARDWARE BY DOOR MANUFACTURER

END OF SECTION 087100

**SECTION 088000 - GLAZING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

**B. Related Requirements:**

1. Section 088300 "Mirrors."
2. Section 088813 "Fire-Rated Glazing."
3. Section 088853 "Security Glazing."

**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 square.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch 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.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer manufacturers of fabricated glass units.
- B. Product Certificates: For glass.
- C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. 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.

**1.8 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.

**1.9 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.

**1.10 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.
- C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.
  - 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.

**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. 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. 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, whichever is less.
  - 3. 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.
- C. Windborne-Debris-Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 4 for basic protection.
  - 1. Large-Missile Test: For glazing located within 30 feet of grade.
  - 2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.
- 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 12 mm.
  - 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.
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. NGA Publications: "Glazing Manual."
  2. 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. 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.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGC Glass Company North America, Inc.
    - b. Cardinal Glass Industries, Inc.
    - c. Guardian Glass LLC.

- d. Pilkington North America; NSG Group.
  - e. Saint-Gobain Glass Corp.
  - f. Vitro Architectural Glass.
- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AGC Glass Company North America, Inc.
    - b. Guardian Glass LLC.
    - c. Pilkington North America; NSG Group.
    - d. Saint-Gobain Glass Corp.
    - e. Vitro Architectural Glass.
- C. 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.
- D. 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.
- E. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cardinal Glass Industries, Inc.
    - b. Guardian Glass LLC.
    - c. Pilkington North America; NSG Group.
    - d. Saint-Gobain Glass Corp.
    - e. Vitro Architectural Glass.

## 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.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Saint-Gobain Glass Corp.
- 2) Technoform Glass Insulation North America.
- 3) Thermix; a brand of Ensinger USA.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.6 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 or Silicone 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 or Silicone 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.

## 2.7 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, ambient; 180 deg F, 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.
  - 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-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. 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 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.

**3.5 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.

**3.6 MONOLITHIC GLASS SCHEDULE**

- A. Clear Glass Type: Full tempered float glass.
  - 1. Minimum Thickness: 12 mm.
  - 2. Safety glazing required.

**3.7 INSULATING GLASS SCHEDULE**

- A. Low-E-Coated, Tinted Insulating Glass Type:
  - 1. Basis-of-Design Product: Solarban 60 Solargray.
  - 2. Overall Unit Thickness: 1 inch.
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outdoor Lite: Tinted annealed (Fully Tempered when required) float glass.
  - 5. Tint Color: Gray.
  - 6. Interspace Content: Argon.
  - 7. Indoor Lite: Clear annealed (Fully tempered where required) float glass.
  - 8. Low-E Coating: Sputtered on second surface.
  - 9. Winter Nighttime U-Factor: .29 maximum.
  - 10. Summer Daytime U-Factor: .27 maximum.
  - 11. Visible Light Transmittance: 70 percent minimum.
  - 12. SGHC: .45 maximum.
  - 13. Safety glazing required.

END OF SECTION 088000

**SECTION 088300 - MIRRORS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Silvered flat glass mirrors.
- B. Related Requirements:
  - 1. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

**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 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of mirror.
- C. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.
- D. Sample Warranty: For special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For mirrors to include in maintenance manuals.



**1.5 QUALITY ASSURANCE****1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mirrors in accordance with 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.

**1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

**1.8 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 SOURCE LIMITATIONS**

- A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- B. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

**2.2 SILVERED FLAT GLASS MIRRORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
  - 1. Gilded Mirrors, Inc.
  - 2. National Glass Industries, Inc.
  - 3. Walker Glass Co., Ltd.

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- B. Mirrors, General: ASTM C1503; manufactured using copper-free, low-lead mirror coating process.
- C. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
  - 1. Nominal Thickness: 4.0 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, provide products by one of the following:
    - a. C.R. Laurence Co., Inc.; CRH Americas, Inc.
    - b. Liquid Nails; PPG Industries, Inc.
    - c. Pecora Corporation.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

### **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. Aluminum J-Channel Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Andscot Company, Inc.
      - 2) C.R. Laurence Co., Inc.; CRH Americas, Inc.
      - 3) Stylmark, Inc.

2. Aluminum J-Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Andscot Company, Inc.
      - 2) C.R. Laurence Co., Inc.; CRH Americas, Inc.
      - 3) Stylmark, Inc.
  3. Finish: Clear bright anodized.
- B. Aluminum J-Channels and Cleat: 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. Aluminum J-Channel and Cleat, Bottom and Side Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch in height, respectively.
  2. Aluminum J-Channel and Cleat, Top Trim: Formed with front leg with a height matching bottom trim and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
  3. Finish: Clear bright anodized.
- C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- D. 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. Shop fabricate mirrors 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.

**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 National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
  - 1. NGA Publications: "Laminated Glazing Reference Manual," "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."
- B. Provide a minimum airspace of 1/8 inch 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 thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
  - 2. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
  - 3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.
  - 4. Install mastic as follows:
    - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.

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- 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 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 and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 088300

**SECTION 088813 - FIRE-RATED GLAZING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Fire-resistance-rated glazing.

**1.2 DEFINITIONS**

- A. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat
- B. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- C. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

**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.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and glass testing agency.
- B. Product Certificates: For each type of glass and glazing product.
- C. Sample Warranties: For special warranties.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

**1.7 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.

**1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

**1.9 WARRANTY**

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

- 1. Warranty Period: Five years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumescent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

- 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Glass: For each glass type, obtain from single source from single manufacturer.
- B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

**2.3 GLASS PRODUCTS, GENERAL**

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

**2.4 GLASS PRODUCTS**

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
  - 2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.

**2.5 FIRE-RESISTANCE-RATED GLAZING**

- A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.
- B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.
- C. Fire-Resistance-Rated Framing and Doors: Fire-resistance-rated glazing with 60-, 90-, and 120-minute ratings requires framing and doors from glass supplier, tested as an assembly complying with ASTM E119 or UL 263.
- D. Fire-Resistance-Rated Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, clear float glass; with intumescent interlayers; complying with 16 CFR 1201, Category II.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. McGrory Glass, Inc.
- b. Pilkington North America; NSG Group.
- c. Vetrotech Saint-Gobain.

- E. Fire-Resistance-Rated Tempered Glazing Units with Clear Intumescent Interlayer: Glazing units made from two or more lites of uncoated, fully tempered, clear float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent polymer; complying with 16 CFR 1201, Category II.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. SAFTI FIRST Fire Rated Glazing Solutions.

## 2.6 GLAZING ACCESSORIES

- A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
  1. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- C. 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 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

**2.7 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. 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.
- C. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

**2.8 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.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.
- 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 fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

**3.3 GLAZING, GENERAL**

- A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

- B. 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.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. 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.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 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-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.
- H. 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.
- I. Set glass lites with proper orientation so that coatings face fire side or protected side 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 and then to jambs. Cover horizontal framing joints by applying tapes to jambs and 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.
- D. 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. 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.
- 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.

END OF SECTION 088813

**SECTION 088853 - SECURITY GLAZING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes:
  - 1. Laminated-glass security glazing
- B. Related Requirements:
  - 1. Section 085653 "Security Windows."

**1.2 DEFINITIONS**

- A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

**1.3 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Statements: For installers.
- B. Sample warranties.

**1.6 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Installers: Fabricator of products.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating security glazing and with air-gap security glazing manufacturers' written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

**1.8 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 below 40 deg F.

**1.9 WARRANTY**

- A. Special Warranty, Laminated-Glass Security Glazing: Manufacturer agrees to replace laminated-glass security glazing that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated-glass security glazing contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain each type of security glazing from single source from single manufacturer.
  - 1. Obtain glass from single source from single manufacturer.
- B. Obtain glazing sealants and gaskets from single source from single manufacturer for each product and installation method.

**2.2 PERFORMANCE REQUIREMENTS****A. General:**

1. Installed security glazing will withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or 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.
2. Installed security glazing will withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

**B. Structural Performance:** Glazing will withstand the following design loads within limits and under conditions indicated.

1. Design Procedure for Glass: ASTM E1300 and the IBC.
2. Design Wind Pressures: As indicated on Drawings.

**C. Thermal Movements:** Allow for thermal movements from ambient and surface temperature changes.**D. Temperature Change:** 120 deg F, ambient; 180 deg F, material surfaces.**E. Windborne-Debris Impact Resistance:** Exterior security glazing passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 4 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet of grade.
2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.

**F. Safety Glazing:** Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.**2.3 SECURITY GLAZING, GENERAL****A. Glazing Publications:** Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. AAMA Publications: AAMA GDSG-1 and AAMA TIR-A7.
2. NGA Publications: "Laminated Glazing Reference Manual" and "GANA Glazing Manual."

**B. Plastic Glazing Labeling:** Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.**C. Safety Glazing Labeling:** Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council or manufacturer. Label will indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.



- D. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Fire-Test-Response Characteristics of Polycarbonate Sheets: As determined by testing polycarbonate sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.
  - 1. Self-ignition temperature of 650 deg F or more when tested in accordance with ASTM D1929 on plastic sheets in thicknesses indicated for the Work.
  - 2. Smoke-Developed Index of 450 or less when tested in accordance with ASTM E84 or UL 723, or smoke density of 75 or less when tested in accordance with ASTM D2843 on plastic sheets in thicknesses indicated for the Work.
  - 3. Burning extent of 1 inch or less when tested in accordance with ASTM D635 at a nominal thickness of 0.060 inch or thickness indicated for the Work.
- F. Thermal and Optical Performance Properties: Provide security glazing with performance properties specified, as indicated in manufacturer's published test data, based on construction products indicated and on procedures indicated below:
  - 1. 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.
  - 2. 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 7.7 computer program.
  - 3. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

## 2.4 LAMINATED-GLASS SECURITY GLAZING

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. School Guard Glass – SG4
- B. Laminated-Glass Security Glazing: ASTM C1172. Two or more glass lites bonded with interlayer. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 2. Interlayer Color: Clear unless otherwise indicated.

## 2.5 SPALL-RESISTANT FILM

- A. Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.
- B. Laminating Process: Factory laminate spall-resistant film to glazing assemblies to produce laminated lites free of foreign substances, air, and glass pockets.

**2.6 GLAZING SEALANTS****A. General:**

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, 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 security glazing 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. Glazing Sealant:**

1. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Pecora Corporation.
    - 2) Sika Corporation.
    - 3) Tremco Incorporated.

**2.7 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 security glazing manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

**B. Expanded Cellular Glazing Tapes:** Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

**2.8 MISCELLANEOUS GLAZING MATERIALS**

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of security glazing 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 or Silicone 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 security glazing manufacturer to maintain security glazing lites in place for installation indicated.
  - 2. Type recommended in writing by sealant or security glazing manufacturer.
- E. Edge Blocks:
  - 1. EPDM or Silicone with Shore A durometer hardness in accordance with manufacturer's written instructions.
  - 2. Type recommended in writing by sealant or security glazing 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.

**2.9 FABRICATION OF SECURITY GLAZING**

- A. Fabricate security glazing 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.
- B. Grind smooth and polish exposed security glazing edges and corners.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine framing for security glazing, 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 system.

3. Minimum required face or edge clearances.
4. Minimum required bite.
5. Effective sealing between joints of 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 security glazing 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 will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of it off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and 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 glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
- F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
  1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. 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 performance requirements.
  2. Provide 1/8-inch minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness of slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and in accordance with requirements in referenced glazing publications.

- H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set coated security glazing with proper orientation so that coatings and films 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 security glazing, 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 and then to jambs. Cover horizontal framing joints by applying tapes to jambs and 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 just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center security glazing 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 in writing by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glazing unit 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 security glazing 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 security glazing. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

- D. Installation with Pressure-Glazing Stops: Center security glazing 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 security glazing. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine security glazing 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 security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.
- C. Wash security glazing on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

### 3.7 LAMINATED-GLASS SECURITY GLAZING SCHEDULE

- A. Security Glazing: Clear laminated glass.
  - 1. Basis-of-Design Product: School Guard Glass – SG4
  - 2. Forced-Entry Resistance, ASTM F1233: Class 1.0 in accordance with ASTM F1233.
  - 3. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.
  - 4. Ballistic Resistance, ASTM F1233: Class HG1 in accordance with ASTM F1233.
  - 5. Ballistic Resistance, UL 752: Level 1 in accordance with UL 752.
  - 6. Maximum Overall Unit Thickness: ½”.
  - 7. Provide safety glazing labeling.
- B. Security Glazing: Tinted laminated glass with clear glass and tinted interlayer.
  - 1. Basis-of-Design Product: School Guard Glass – SG4
  - 2. Forced-Entry Resistance, ASTM F1233: Class 1.0 in accordance with ASTM F1233.
  - 3. Forced-Entry Resistance, HPW-TP-0500.03: Level I in accordance with HPW-TP-0500.03.

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4. Ballistic Resistance, ASTM F1233: Class HG1 in accordance with ASTM F1233.
5. Maximum Overall Unit Thickness: ½”.
6. Basis-of-Design Product: Solarban 60 Solargray.
7. Outdoor Lite: Tinted annealed (Fully Tempered when required) float glass.
8. Tint Color: Gray.
9. Indoor Lite: Clear annealed (Fully tempered where required) float glass.
10. Low-E Coating: Sputtered on second surface.
11. Winter Nighttime U-Factor: .29 maximum.
12. Summer Daytime U-Factor: .27 maximum.
13. Visible Light Transmittance: 70 percent minimum.
14. SGHC: .45 maximum.
15. Safety glazing required.

END OF SECTION 088853

**SECTION 092216 - 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 054000 "Cold-Formed Metal Framing" for exterior and interior 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.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks firestop tracks post-installed anchors and power-actuated fasteners, 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 one of the product-certification program of: the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

**1.5 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. 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.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..
- 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. minimum as required by the IBC.
- F. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection imposed on it.

### 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 for conditions indicated.
  - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
  - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
    - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: AISI S220.
  - 1. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.

2. Depth: As indicated on Drawings.
- C. High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
  1. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.
  2. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide the following:
  1. Double-Track System: Top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
  2. 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.
- E. 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.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  1. Minimum Base-Steel Thickness: As indicated on Drawings.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
  1. Depth: 1-1/2 inches.
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels:
  1. Minimum Base-Steel Thickness: 0.0179 inch.
  2. Depth: As indicated on Drawings.
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
  1. Configuration: Asymmetrical.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
  1. Depth: 3/4 inch.
  2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
  3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 3/4 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
  - 1. Depth: 2-1/2 inches.
- F. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  - 2. Steel Studs and Tracks:
    - a. Minimum Base-Steel Thickness: 0.0179 inch.
    - b. Depth: As indicated on Drawings.
  - 3. High-Strength Steel Studs and Tracks:
    - a. Minimum Base-Steel Thickness: 0.0147 inch.
    - b. Depth: As indicated on Drawings.
  - 4. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.
    - a. Minimum Base-Steel Thickness: As indicated on Drawings.
  - 5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
    - a. Configuration: Asymmetrical or hat shaped.

## 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.

**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 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.

**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.
- 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 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 o.c.
- E. Direct Furring:
  - 1. Screw to wood framing.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

**F. Z-Shaped Furring Members:**

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

**G. Installation Tolerance:** Install each framing member so fastening surfaces vary not more than 1/8 inch 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 o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches 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, countersplaying, 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 measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

**SECTION 092900 - GYPSUM BOARD****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Interior gypsum board.
2. Tile backing panels.

**B. Related Requirements:**

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

**1.2 ACTION SUBMITTALS****A. Product Data: For the following:**

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Glass-mat interior gypsum board.
4. Water-resistant gypsum backing board.
5. Joint treatment materials.
6. Sound-attenuation blankets.
7. Acoustical sealant.

**B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.****1.3 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.****1.4 FIELD CONDITIONS****A. Environmental Limitations: Comply with ASTM C840 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 blotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.
- C. 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 C1396/C1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  - 2. Thickness: 5/8 inch.
  - 3. Long Edges: Tapered.
- B. Gypsum Board, Type X: ASTM C1396/C1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.

- b. Georgia-Pacific Gypsum LLC.
  - c. USG Corporation.
- 2. Thickness: 5/8 inch.
- 3. Long Edges: Tapered.

## 2.4 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  - 2. Core: 5/8 inch, Type X.
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products.
    - b. PermaBASE Building Products, LLC provided by National Gypsum Company.
    - c. USG Corporation.
  - 2. Thickness: 5/8 inch.
  - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  - 2. Core: 5/8 inch, Type X.

## 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. L-Bead: L-shaped; exposed long flange receives joint compound.
    - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - e. Base-of-Wall Galvanized Moisture Barrier Trim: Galvanized-steel sheet, 2 inches high.
      - 1) Manufacturers: Subject to compliance with requirements, provide products by the following:
        - a) VersaDry, LLC.
    - f. Base-of-Wall PVC Moisture Barrier Trim: Extruded PVC, 1/2 inch high.
      - 1) Manufacturers: Subject to compliance with requirements, provide products by the following:
        - a) Waterguard.
- B. Exterior Trim: ASTM C1047.
1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
  2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
- C. 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 Corporation.
    - b. Gordon Inc.
    - c. Tamlyn.
  2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
  3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.

**B. Joint Tape:**

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. 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 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 setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

**D. Joint Compound for Tile Backing Panels:**

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

**2.7 AUXILIARY MATERIALS**

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, 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.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

## 2.8 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.

## 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 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- 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 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. 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-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-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. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Wallboard Type: As indicated on Drawings.
  - 2. Type X: As indicated on Drawings.
  - 3. Glass-Mat Interior Type: As indicated on Drawings.
- 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. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
  - 1. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
  - 2. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

**3.4 INSTALLATION OF 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 on Drawings locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

**3.5 INSTALLATION OF 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 in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners.
  - 2. LC-Bead: Use at exposed panel edges.
  - 3. U-Bead: Use at exposed panel edges.
  - 4. Curved-Edge Cornerbead: Use at curved openings.

**3.6 FINISHING OF 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 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 in accordance with ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. 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 099123 "Interior Painting."
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

**3.7 APPLICATION OF TEXTURE FINISHES**

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written instructions.

**3.8 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 092900



**SECTION 093013 - CERAMIC TILING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Ceramic mosaic tile.
  - 2. Tile backing panels.
  - 3. Waterproof membranes.
  - 4. Setting material.
  - 5. Grout materials.
- B. Related Requirements:
  - 1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
  - 2. Section 092900 "Gypsum Board" for tile backing panels.

**1.2 DEFINITIONS**

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Large Format Tile: Tile with at least one edge 15 inches or longer.
- D. Module Size: Actual tile size plus joint width indicated.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Ceramic mosaic tile.
  - 2. Tile backing panels.
  - 3. Waterproof membranes.
  - 4. Setting material.
  - 5. Grout materials.
- B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement 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. Full-size units of each type of trim and accessory.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product, including product use classification.
- C. Product Test Reports:
  - 1. Tile-setting and -grouting products.
  - 2. Certified porcelain tile.
  - 3. Slip-resistance test reports from qualified independent testing agency.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match 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.

**1.6 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.

**1.7 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" Article in the Evaluations and manufacturer's written instructions.

**1.8 WARRANTY**

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

1. Warranty Period: 25 years from date of Product Purchase.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Tile: Obtain tile of each type 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. Tiling System: Obtain system products 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 underlayment from manufacturer of setting and grouting materials.
  3. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
  4. Obtain joint sealants from manufacturer of setting and grouting materials.
- C. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
  1. Backer units.

### 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  1. Provide tile complying with Standard Grade requirements.
- 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. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

## 2.3 PORCELAIN TILE

### A. Porcelain Tile Type: Glazed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Olean; Division of Dal-Tile International Inc.
  - b. Crossville, Inc.
  - c. Daltile; Division of Dal-Tile International Inc.
  - d. Anatolia
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: Per the drawings.
4. Face Size Variation: Rectified.
5. Thickness: 3/8 inch.
6. Product Use Classification: Interior, Wet (IW).
7. Tile Color, Glaze, and Pattern: Per the drawings.
8. Grout Color: Per the drawings.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. Base Cap: Surface bullnose, module size same as adjoining flat tile Insert size.

## 2.4 TILE BACKING PANELS

### A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges in maximum lengths available to minimize end-to-end butt joints.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. C-Cure; C-Cure Board 990.
  - b. Custom Building Products; Wonderboard.
  - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
  - d. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

### B. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges. Gypsum backing board is not permitted for use as a backing board for tile shower areas or as wall board or ceiling panels in shower areas.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  2. Core: As indicated on Drawings.
- C. Glass-Mat, Water-Resistant Gypsum Panel: ASTM C1658/C1658M, with fiberglass mat partially or completely embedded into the core.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. Georgia-Pacific Gypsum LLC.
    - c. USG Corporation.
  2. Core: As indicated on Drawings.
  3. Long Edges: Tapered.
  4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

## 2.5 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
- A. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Schluter Systems L.P.; KERDI.
- A. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Boiardi Products; a QEP company; Elastiment 323 Cement Based Waterproofing, Anti-Fracture/Crack Suppression Membrane.
    - b. C-Cure; UltraCure 971.
    - c. MAPEI Corporation; Mapelastic (PRP 315).
    - d. Southern Grouts & Mortars, Inc.; Southcrete 1100.
    - e. TEC; a subsidiary of H. B. Fuller Company; Triple Flex Waterproofing, Crack Isolation Membrane & Mortar.

**2.6 CRACK ISOLATION MEMBRANES**

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

**2.7 SETTING MATERIALS**

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
  - 1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  - 2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
  - 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.

**2.8 GROUT MATERIALS**

- A. Standard Cement Grout: ANSI A118.6.
- B. High-Performance Tile Grout: ANSI A118.7.
  - 1. Polymer Type:
    - a. Dry, redispersible form, prepackaged with other dry ingredients.
    - b. Liquid-latex form for addition to prepackaged dry-grout mix.

**2.9 MISCELLANEOUS MATERIALS**

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.
- C. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
  - 2. Description: L-shaped or Square Insert profile.
  - 3. Material and Finish: Metallic or combination of metal and PVC or neoprene base; per the drawings exposed-edge material.

- A. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Blanke Corporation.
    - b. Ceramic Tool Company, Inc.
    - c. Schluter Systems L.P.
- B. 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.
- C. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bonsal American, an Oldcastle company; Grout Sealer.
    - b. Custom Building Products; Surfaceguard Sealer.
    - c. Jamo Inc.; Surfaceguard Sealer.
    - d. Southern Grouts & Mortars, Inc.; Clear Penetrating Sealer & Grout Release.
    - e. Summitville Tiles, Inc.; SL-15, Invisible Seal.
    - f. TEC, H. B. Fuller Construction Products Inc.; Grout Guard Penetrating Grout Sealer.

### 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. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.
- B. 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.
- C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.
- D. 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.
- E. Substrate Flatness:
  1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
  2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.
- F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
  1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.



- C. 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.
  - 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.
  - 1. Add materials, water, and additives in accurate proportions.
  - 2. 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.
- E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Exterior tile floors and walls.
    - b. Tile floors in wet areas.
    - c. Tile swimming pool decks.
    - d. Tile floors in laundries.
    - e. Tile floors consisting of tiles 8 by 8 inches or larger.
    - f. Tile floors consisting of rib-backed tiles.
  - 2. 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.
  - 3. 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.
  - 4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
  - 5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
  - 6. 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 use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
    - a. 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.
    - b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    - c. 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.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

H. Metal Wall Trim: Install at locations indicated on Drawings.

I. Grout Sealer: Apply grout sealer to grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 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 in accordance with tile and grout manufacturer's written instructions. 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.

### 3.5 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.

**3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE****A. Interior Floor Installations, Concrete Subfloor:**

1. TCNA F125-Full CT-1, CT-4: Thinset mortar on crack isolation membrane.
  - a. Ceramic Tile Type: CT-1, CT-4.
  - b. Thinset Mortar: Modified dry-set mortar.
  - c. Grout: Standard unsanded cement grout.
  - d. Crack Isolation Membrane: As recommended by setting material manufacturer.
  - e. Joint Width: 1/8 inch.
  - f. Movement Joints: Types located on Drawings.

**B. Interior Wall Installations, Wood or Metal Studs or Furring:**

1. TCNA W245 CT-2, CT-3, CT-5: Thinset mortar on glass-mat, water-resistant gypsum backer board.
  - a. Ceramic Tile Type: CT-2, CT-3, CT-5.
  - b. Thinset Mortar: Modified dry-set mortar.
  - c. Grout: Standard unsanded cement grout.
  - d. Waterproof Membrane: As recommended by setting material manufacturer.
  - e. Joint Width: 1/8 inch 3/16 inch 1/4 inch 3/8 inch Insert width.
  - f. Movement Joints: Types located on Drawings.

**SECTION 095113 - ACOUSTICAL PANEL CEILINGS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

**B. Related Requirements:**

- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

- C. Samples for Initial Selection: For components with factory-applied finishes.

- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Insert size Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

**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.

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 for wood panel ceiling type CLG-5:
  - 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.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes 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. 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.
4. Impact Clips: Equal to 2 percent of quantity installed.

#### 1.6 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.

**1.7 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.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Source Limitations for Ceiling System: 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 E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A B C in accordance with ASTM E1264.
  - 2. Smoke-Developed Index: 50 or less.
- B. 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 or from the listings of another qualified testing agency.

**2.3 ACOUSTICAL PANELS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Armstrong Ceiling & Wall Solutions.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Color: As indicated on Drawings.
- D. Light Reflectance (LR): Not less than 0.85.
- E. Ceiling Attenuation Class (CAC): Not less than 25.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.

- G. Articulation Class (AC): Not less than 190.
- H. Edge/Joint Detail: As indicated by manufacturer's designation.
- I. Thickness:
  - 1. 5/8 inch.
- J. Modular Size: As indicated on Drawings.
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

## 2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong Ceiling & Wall Solutions.
  - 2. CertainTeed; SAINT-GOBAIN.
  - 3. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.
  - 1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.
- 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 coating designation; with prefinished 15/16-inch-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: Painted to match color indicated by manufacturer's designation.

## 2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - 2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.

3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
  4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- F. Hold-Down Clips: Manufacturer's standard hold-down.
- G. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Armstrong Ceiling & Wall Solutions.
- B. 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. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

# 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 OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
  - 1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.
- 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. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 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 o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches 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. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  - 3. 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 as required; space in accordance with panel manufacturer's written instructions unless otherwise indicated.
    - a. Hold-Down Clips: Space 24 inches 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, 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 Insert dimensions, 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 095113

**SECTION 095426 - SUSPENDED WOOD CEILINGS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Solid-wood, linear-panel ceilings.

**1.2 DEFINITIONS****A. NRC: Noise Reduction Coefficient.****1.3 COORDINATION**

- A. Coordinate layout and installation of wood ceilings and suspension systems with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

**1.4 ACTION SUBMITTALS****A. Product Data: For each type of product.**

1. Solid-wood, linear-panel ceilings.

**B. Shop Drawings: For suspended wood ceilings.**

1. Include reflected ceiling plans, sections, and details, drawn to scale, showing the following:
  - a. Wood ceiling patterns and joints.
  - b. Ceiling suspension members.
  - c. Method of attaching hangers to building structure and locations of cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  - d. Ceiling-mounted items including, but not limited to, light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
  - e. Ceiling perimeter and penetrations through ceiling; trim and moldings.

**C. Samples: For each exposed product and for each type, color, and finish specified, 12 inches long by 12 inches wide or full width in size.****D. Samples for Verification: For the following products:**

1. Wood Ceilings: 12-inch-long by 12-inch-wide or full-width Samples of each type, color, and finish.
2. Veneer Edge Banding: Applied to a cut end of a wood-ceiling Sample for each type, color, and finish.
3. Filler Strips: 12-inch-long Samples of each type, color, and finish.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in 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. Suspended-Wood-Ceiling Components: Quantity of each wood-ceiling unit, suspension-system component, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ceiling components and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
  1. Store materials flat and level, raised from the floor.
- B. Handle ceiling components and accessories in a manner that prevents damage.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
  1. Store and acclimatize wood products in the spaces where they will be installed for a minimum of 72 hours immediately before ceiling installation.

**PART 2 - PRODUCTS****2.1 SOLID-WOOD, LINEAR-PANEL CEILINGS**

- A. Solid-Wood Linear Ceiling Panels: Manufacturer's standard linear panels fabricated from kiln-dried solid-wood planks free of knots and without finger joints, cracks, checks, or warp. Planks run parallel to panel length.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Armstrong World Industries, Inc. Woodworks 8177 W1
  2. Plank Species: Poplar.
  3. Plank Cut: Manufacturer's standard.
  4. Plank Width: 5 1/4 inches.
  5. Plank Depth: 3/4 inch.
  6. Plank Length: 96 inches nominal; 95 inches actual with 1inch reveal panel to panel @ lengths.
  7. Plank Edges: Square.
  8. Reveal/Plank Spacing: Equal spacing between long edges of planks.
  9. Backing Boards: Manufacturer's standard, 1/2-inch-thick solid-wood boards or HPVA HP-1 hardwood plywood.
  10. Panel Module: 12 by 96 by 1-1/4 inches.
  11. Panel Attachment: Provide black, zinc-aluminum coated steel sheet metal screws recommended in manufacturer's written installation instructions through factory pre-drilled holes in backing boards for attaching panels to grid suspension system, spaced to support ceiling and in accordance with manufacturer's written installation instructions.
  12. Factory Finish: Manufacturer's standard interior finish; applied on every wood surface.
    - a. Surface-Burning Characteristics: Provide manufacturer's standard intumescent finish system with the following characteristics when tested in accordance with ASTM E84:
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 450 or less.
    - b. Plank Finish: Clear.
    - c. Plank Stain: Per the drawings.
    - d. Plank Gloss: Manufacturer's standard.
    - e. Backing Board Gloss and Color: Flat black.
- B. Linear-Ceiling-Panel Accessories: Linear-ceiling-panel manufacturer's accessories required to provide a complete installation of ceiling in accordance with manufacturer's written installation instructions.
1. 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

- a. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- C. Grid Suspension System: ASTM C635/C635M; recommended in writing by ceiling and suspension-system manufacturers for applications indicated; main- and cross-runner system complete with suspension-system components required to support ceiling units and other ceiling-supported construction.
  - 1. Material: ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation ASTM A653/A653M, hot-dip galvanized, cold-rolled sheet steel, G60 coating designation with ASTM B209 aluminum cap.
  - 2. Structural Classification: Heavy-duty system.
  - 3. Face Width: 15/16 inch.
  - 4. Finish: Flat black.

## 2.2 SUSPENSION-SYSTEM HANGERS, BRACES, AND TIES

- A. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
- B. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - 2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
  - 3. Nickel-Copper-Alloy Wire: ASTM B164 nickel-copper alloy UNS No. N04400.
  - 4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- C. Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed from 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended wood 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 suspended wood ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of suspended wood ceilings.
  - 1. Balance border widths at opposite edges of each ceiling.
  - 2. Avoid using less-than-half-width units.

### 3.3 INSTALLATION OF SUSPENDED WOOD CEILINGS

- A. Comply with ASTM C636/C636M and seismic requirement indicated, in accordance with manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- 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 in 3 inches. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
  - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts or postinstalled mechanical or adhesive anchors that extend through forms into concrete.
  - 7. 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.
  - 8. Do not attach hangers to steel deck tabs.
  - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns in 1-1/2 inches. Suspend bracing from building's structural members as required for hangers and without attaching to permanent metal forms, steel deck, or steel deck tabs.



- D. Install edge moldings and trim at perimeter of ceiling area and where necessary to conceal edges and ends of wood units.
  - 1. Screw-attach metal moldings to substrate at intervals of not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners on moldings and trim.
- E. Grid Suspension Systems: Space main beams at 48 inches o.c.
  - 1. Install cross tees to form modules sized in accordance with manufacturer's written installation instructions.
  - 2. Remove and replace dented, bent, or kinked members.
- F. Linear-Carrier Suspension Systems: Install carriers at no more than 24 inches o.c. aligned and securely interlocked with one another.
  - 1. Install stabilizer channels, tees, and bars at regular intervals to stabilize carriers and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated.
  - 2. Remove and replace dented, bent, or kinked members.
- G. Install wood components and accessories in accordance with manufacturer's written instructions and to accommodate natural expansion and contraction of wood products resulting from fluctuations in humidity.
- H. Cut wood components for accurate fit at borders and at interruptions and penetrations by other work through ceilings.
  - 1. Stiffen edges of cut wood components as required to eliminate variations in flatness.
- I. Treat field-cut edges of wood components in accordance with manufacturer's written recommendations; finish exposed field cuts to match factory finish.
  - 1. Solid-Wood Planks: Use solid-wood end caps to conceal exposed field-cut edges.
- J. Install wood components in coordination with suspension system and moldings and trim.
  - 1. Install wood components in patterns indicated on Drawings.
- K. Install field-constructed access panels in locations indicated on Drawings.

### 3.4 CLEANING

- A. Clean exposed surfaces of ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented units.

**SUSPENDED WOOD CEILINGS**

LXT Eastside Development

**SECTION 09 54 23**

Project #47732472

Permit Set 09/29/22

END OF SECTION 095426

**SECTION 096513 - RESILIENT BASE AND ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
  - 1. Thermoplastic-rubber base.
  - 2. Vinyl base.
  - 3. Vinyl molding accessories.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 4 inches long.
- C. Product Schedule: For resilient base and accessory products.

**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 for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

**1.4 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 or more than 90 deg F.

**1.5 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, 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 or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 THERMOPLASTIC-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Johnsonite; a Tarkett company.
  - 2. Equal approved by architect
- B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
  - 1. Group: I (solid, homogeneous).
  - 2. Style and Location:
    - a. Style A, Straight: Per finish schedule.
- C. Thickness: .375.
- D. Height: 4 ½ inches.
- E. Lengths: Cut lengths 96 inches long.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: Per the drawings.

### 2.2 VINYL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Johnsonite; a Tarkett company.
  - 3. Roppe Corporation; Roppe Holding Company.
- B. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).
  - 1. Group: I (solid, homogeneous).
  - 2. Style and Location:
    - a. Style B, Cove: Per the finish schedule.

- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors and Patterns: Per the drawings.

### 2.3 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. Johnsonite; a Tarkett company.
  - 3. Roppe Corporation; Roppe Holding Company.
- B. Description: Vinyl transition strips.
- C. Profile and Dimensions: Per the drawings.
- D. Locations: At doorways.
- E. Colors and Patterns: Per the drawings.

### 2.4 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. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
  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 manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by 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., 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 have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. 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 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.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

**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. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches 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 in length.
    - a. Miter or cope corners to minimize open joints.

**3.4 RESILIENT ACCESSORY INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. 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.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- 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 096513



**PART 1 GENERAL**

1.1 Basis of design Product: Subject to compliance with requirements, provide SikaFloor Multidur HS or comparable product by one of the following:

- a. Master Builders Solutions; brand of MBCC Group.
- b. Neogard; Hempel Group.
- c. PPG Paints; PPG Industries, Inc.
- d. Pecora Corporation.
- e. Sherwin-Williams Company (The).
- f. Tremco Incorporated.

1.2 SECTION INCLUDES

A. Labor, products, equipment and services necessary for resinous flooring Work in accordance with the Contract Drawings covering the following components:

- .1 Primer: Sikafloor® 161.
- .2 Body Coat: Sikafloor® 264.
- .3 1<sup>st</sup> Top Coat: Sikafloor® 340.

1.3 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 03 39 00 - Concrete Curing.

1.4 REFERENCES

- A. ASTM C579, Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- B. ASTM D2240, Standard Test Method for Rubber Property—Durometer Hardness.
- C. ASTM D2369, Standard Test Method for Volatile Content of Coatings.
- D. ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. For additional standards please refer to Product Data Sheets

1.5 SUBMITTALS

- A. Comply with Section 01 33 00 - Submittal Procedures.
- B. Product Data for each type of product: Submit manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required, including physical properties and colors available.
- C. Manufacturer's Safety Data Sheet for each product being used.

- D. Product Samples: Submit Architectural Standard samples representative of the final finish, as applied. The Standard shall be approved in writing by the Architect and shall be the final standard of acceptance of the finish.
- E. Maintenance Instructions: Submit manufacturer's maintenance instructions.

**1.6 QUALITY ASSURANCE****A. Manufacturer Qualifications:**

- .1 Acceptable Manufacturer: Sika Corporation, 201 Polito Drive, Lyndhurst, NJ 07071
  - .1 No request for substitution shall be considered that would change the generic type of system specified. Equivalent materials of other manufacturers may be substituted only on approval of the Architect or Engineer. Requests shall include the respective manufacturer's technical literature for each product giving the name, generic type, descriptive information, recommended dry film thickness (DFT), Material Safety Data Sheet (MSDS), and certified test reports showing results of performance criteria of products specified herein.

**B. Applicator Qualifications:**

- .1 Pre-Qualification: Each bidder for this project shall be pre-qualified and approved in writing by the material manufacturer.
- .2 Applicator Experience: Each bidder must have a minimum 5 years experience in the application of the type of system specified. Contractor shall submit a list of five projects of similar size, scope and complexity.

**C. Mock-Up:**

- .1 Construct one 100 sq.ft. (10 sq.m.) mock-up of resinous flooring in location acceptable to Architect/Engineer to demonstrate quality of finished system, complying with manufacturer's instructions.
- .2 Arrange for Architect/Engineer's review and acceptance, obtain written acceptance before proceeding with Work.
- .3 Upon acceptance, mock-up shall serve as a minimum standard of quality for the balance of the work of this Section. Mock-up shall be left in place for the duration of the work.

- D. Pre-application Meeting: Convene a pre-application meeting minimum one week before start of application of floor coating at project site. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator, and manufacturer's representative. Review surface preparation, priming, application, curing, protection, and coordination with other work.

**1.7 DELIVERY, STORAGE AND HANDLING****A. Delivery:**

- .1 Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, manufacturer, batch or lot number, and date of manufacture.

- .2 Material should be delivered to job site and checked for completeness and shipping damage prior to job start.
- B. Storage:
  - .1 Store materials in accordance with manufacturer's written instructions.
  - .2 Keep containers sealed until ready for use. Material should be stored in a dry, enclosed, protected area from the elements.
  - .3 Do not subject material to excessive heat or freezing.
  - .4 Shelf life: Established based on manufacturer's written recommendation for each material being used.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.
- D. Condition materials for use accordingly to manufacturer's written instructions prior to application.
- E. Record material lot number and quantity delivered to jobsite/storage.

**1.8 SITE CONDITIONS**

- A. Do not install the Work of this Section outside of the following environmental ranges with Manufacturers' written acceptance:
  - .1 Material Temperature: Precondition material for at least 24 hours between 65° to 75°F (18° to 24°C)
  - .2 Ambient Temperature: Minimum/Maximum 50°/85°F (10°/30°C)
  - .3 Substrate Temperature: Minimum/Maximum 50°/85°F (10°/30°C). Substrate temperature must be at least 5°F (3°C) above measured Dew Point.
  - .4 Mixing and Application attempted at Material, Ambient and/or Substrate Temperature conditions less than 65°F (18°C) will result in a decrease in product workability and slower cure rates.
  - .5 Relative Ambient Humidity: Minimum ambient humidity 30%, maximum ambient humidity 75% (during application and curing)
  - .6 Measure and confirm Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.
- B. Substrate moisture:
  - .1 Moisture content of concrete substrate must be  $\leq 4\%$  by mass as measured with a Tramex® CME/CMExpert type concrete moisture meter.
  - .2 Additionally, relative humidity tests may be conducted per ASTM F2170 and values must be  $\leq 85\%$ .
  - .3 If moisture content of concrete substrate is  $> 4\%$  by mass as measured with Tramex® CME/CMExpert type and/or if relative humidity tests per ASTM F2170 exceed values  $> 85\%$ , consider moisture mitigation systems or moisture tolerant primer.
- B. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less

than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer,

- C. Utilities, including electric, water, HVAC and permanent lighting to be supplied by General Contractor
- D. Maintain constant ambient room temperature of plus or minus 15°F (plus or minus 7°C) with a minimum temperature of 50°F (10°C) and maximum temperature of 85°F (30°C). Maintain constant ambient room temperature for 48 hours before, during and after installation, or until cured. Do not apply while ambient and temperatures are rising.
- E. Erect suitable barriers and post legible signs at points of entry to prevent traffic and trades from entering the work area during application and cure period of the floor.
- F. Protection of finished floor from damage by subsequent trades shall be the responsibility of the General Contractor.
- G. Insure adequate ventilation and air flow.

## 1.9 WARRANTY

- C. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Adhesive or cohesive failures.
    - b. Abrasion or tearing failures.
    - c. Surface crazing or spalling.
    - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 Products

### 2.1 MANUFACTURER

- A. Manufacturer shall be certified under ISO 9001: 2008 All liquid materials, including primers, resins, curing agents, finish coats, and sealants are manufactured and tested under an ISO 9001:2008 registered quality system.
- B. Approved Manufacturer shall be Sika Corporation, Industrial Flooring, 201 Polito Avenue, Lyndhurst, NJ 07071, Phone 201.933.8800, Fax 201.933.6225, [www.sikafloorusa.com](http://www.sikafloorusa.com)
- C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

**2.2 SYSTEM**

- A. Resinous flooring system: Sikafloor Multidur Hangar System is a monolithic solid color flooring system offering chemical resistance, applied between 28 - 38 mils thick. System to consist of the following components:
- .1 Primer: Sikafloor 161 applied between 8 – 10 mils.
  - .2 Body coat: Sikafloor 264 applied between 12 - 16 mils.
  - .3 1<sup>st</sup> top coat: Sikafloor 340 applied at 4 - 6 mils.

**2.3 MATERIALS**

- A. Primer: Sikafloor 161 is a two part, epoxy resin for priming and leveling mortars with the following properties:
- .1 Pull-off Strength (ASTM D4541): > 400 psi (2.7 MPa) with 100% concrete failure.
  - .2 Shore D Hardness (ASTM D2240): 76 at 7 days.
  - .3 Solid Content: ~ 100% (by volume) / ~ 100% (by weight).
  - .4 VOC Content (ASTM D2369): ≤ 50 g/L.
  - .5 Permeability (ASTM E96): 9.0 g/m<sup>2</sup> (24 hours / +75°F).
  - .6 Water Absorption (ASTM D570): 0.14 g/h - m<sup>2</sup>.
  - .7 Viscosity (approximately) of Components A + B: 775 (SP2/100).
- B. Body Coat: Sikafloor 264 is a pigmented two part, low viscosity, self-priming, epoxy coating binder in [*Refer to Sikafloor color chart*] color with the following properties:
- .1 Pull-off Strength (ASTM D4541): > 400 psi (2.7 MPa) with 100% concrete failure.
  - .2 Shore D Hardness (ASTM D2240): 76 at 7 days.
  - .3 Solid Content: ~ 100% (by volume) / ~ 100% (by weight).
  - .4 VOC Content (ASTM D2369): ≤ 50 g/L.
  - .5 Compressive Strength (ASTM C579): 7,250 psi (50 N/mm<sup>2</sup>) at 28 days.
  - .6 Flexural Strength (ASTM C580): 2,900 psi (20 N/mm<sup>2</sup>) at 28 days.
- C. Top Coat: Sikafloor 340 is an aliphatic urethane with excellent chemical resistance and UV resistance coating in [*Refer to Sikafloor color chart*] color with the following properties:
- .1 VOC Content (ASTM D2369): ≤ 280 g/L.
  - .2 UV Light Resistance - Q-U-V Accelerated Weather Tester: Excellent
  - .3 Abrasion Resistance (ASTM D4060): 18 mg loss (CS-17 Wheel, 1000 gm load, 1000 cycles).
  - .4 Flexibility: Bent on 1/8" conical
  - .5 Gloss at 60°: 90
  - .6 Slip Resistance: Equivalent to ASTM D2047 Passes.
- D. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.

**PART 3 EXECUTION****3.1 EXAMINATION**

- A. Examine surfaces to receive flooring system. Notify Architect/General Contractor/Owner/Owner's representative if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected. Do not apply to substrate treatments for moisture, repair, or leveling not of the same Manufacturer.
- B. Surface must be clean, sound and dry. Remove dust, laitance, grease, curing compounds bond inhibiting impregnations, waxes and any other contaminants. All projections, rough spots, etc. should be dressed off to achieve a level surface prior to the application.
- C. Concrete substrate to have a minimum compressive strength of 3,500 psi (24 MPa) at 28 days and a minimum of 215 psi (1.5 MPa) in tension at time of application.
- D. Substrate moisture:
  - .1 Measure and confirm Substrate Moisture Content, Ambient Relative Humidity, Ambient and Surface Temperature and Dew Point.
  - .2 Confirm and record above values at least once every 3 hours during installation, or more frequently whenever conditions change (e.g. Ambient Temperature rise/fall, Relative Humidity increase/decrease, etc.).
- E. Ensure concrete substrate conforms to the minimum requirements of the flooring manufacturer.
- F. Flooring system shall not be applied to sand-cement setting beds. Sand-cement beds shall be removed to structural concrete substrate and re-leveled/sloped as necessary to achieve grade and/or adequate drainage.
- G. Flooring system shall not be applied to asphaltic or bitumen membranes, soft wood, aluminum, copper or fiberglass reinforced polyester/vinyl ester composites.
- H. Application to glazed or vitrified brick and tile, structural wood, steel shall only be permitted with Manufacturer's written recommendation.
- I. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 SURFACE PREPARATION**

- A. Prepare surface to receive flooring systems in accordance with manufacturer's written instructions.
- B. Remove dust, dirt, oil, grease, wax, laitance, glaze, efflorescence, curing compounds, water-soluble concrete hardeners, and other surface contaminants. Remove sealers, finishes, and paints and other contaminants incompatible with resinous flooring. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions
- C. Concrete: Shall be cleaned and prepared to achieve laitance-free and contaminant-free, open textured surface by shot blasting or equivalent mechanical means (CSP level as per ICRI guidelines and manufacturer's written recommendation).
- D. Chemical Surface Preparation: Chemical surface preparation (acid etching) is unacceptable and will void Manufacturer's warranty.

- E. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
- F. Control joints and cracks: Provide repair and treatment of control joints and surface cracks utilizing manufacturer's standard materials and installation details.
  - .1 Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.

### 3.3 APPLICATION

- A. Mix and apply material with strict adherence to manufacturer's written installation procedures and coverage rates.
- B. Follow Manufacturer's written recommendations on terminations and connections to walls, drains, doorways, columns and floor-to-floor transitions.
- C. Do not apply while ambient and substrate temperatures are rising.
- D. Apply resinous flooring with care to ensure that no laps, voids, or other marks or irregularities are visible, and with an appearance of uniform color, sheen and texture, all within limitations of materials and areas concerned.
- E. Match colors and textures of approved samples.
- F. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

### 3.4 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.
  - .1 Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - .2 Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - .3 If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.
- B. Core Sampling: At Owner's direction and at locations designated by Owner, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

**3.5 CLEAN UP**

- A. Disposal of this product, solution and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.
- B. Empty containers should be taken to an approved waste handling site for recycling or disposal.

**3.6 PROTECTION**

- A. Freshly applied material should be protected from dampness, condensation and water for at least 72 hrs.
- B. Beware of air flow and changes in air flow. Introduction of dust, debris, and particles, etc. may result in surface imperfections and other defects.
- C. Follow manufacturer's written recommendation with respect to cure, wait time and return to service.

END OF SECTION



**SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Surface preparation and application of paint systems on exterior substrates, the following exterior substrates:
  - a. Galvanized metal.

**B. Related Requirements:**

1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

**1.2 DEFINITIONS**

- A. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

**1.3 ACTION SUBMITTALS****A. Product Data:** For each type of product.

1. Include preparation requirements and application instructions.
2. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
3. Indicate VOC content.

**B. Samples:** For each type of topcoat product.**C. Samples for Verification:** For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches 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.

- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

#### 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. Paint: 5 percent, but not less than 1 gal. 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 selections made under Sample submittals, to demonstrate aesthetic effects, and to 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..
  - 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.

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.

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## 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. Benjamin Moore & Co.
  - 2. PPG Paints; PPG Industries, Inc.
  - 3. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
  - 4. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide product available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.
- C. Source Limitations: Obtain paint from single source from single manufacturer.

### 2.2 PAINT PRODUCTS

- A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are 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, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architec..

## 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. Concrete: 12 percent.

2. Fiber-Cement Board: 12 percent.
  3. Masonry (Clay and CMUs): 12 percent.
  4. Wood: 15 percent.
  5. Portland Cement Plaster: 12 percent.
  6. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. 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 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. but not less than the following:
1. SSPC-SP 2.
  2. SSPC-SP 3.
- 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 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI 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. Paint entire exposed surface of window frames and sashes.
  5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  6. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. 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.
    - 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 instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

**EXTERIOR PAINTING (MPI STANDARDS)****SECTION 09 91 14**

LXT Eastside Development

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1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  3. Allow empty paint cans to dry before disposal.
  4. Collect waste paint by type and deliver to recycling or collection facility.
- 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. Galvanized-Metal Substrates:**

1. Water-Based Light Industrial Coating System MPI EXT 5.3J:
  - a. Epoxy Prime Coat: Primer, epoxy, anti-corrosive, MPI #101.
  - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
  - c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #163.

PART 4 - END OF SECTION 099114

**SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on interior substrates.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
  - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
  - 3. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
  - 4. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.

**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 D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. 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 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: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

#### 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. Paint: 5 percent, but not less than 1 gal. Insert number 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..
  - 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.

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.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

**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. Benjamin Moore & Co.
  - 2. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
  - 3. PPG Paints; PPG Industries, Inc.
  - 4. Sherwin-Williams Company (The).

**2.2 PAINT, GENERAL**

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. 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.
- C. Colors: As selected by Architect.

**2.3 PRIMERS/SEALERS**

- A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.

**2.4 WATER-BASED PAINTS**

- A. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): MPI #145.

**2.5 FLOOR COATINGS**

- A. Sealer, Water Based, for Concrete Floors: MPI #99.

**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. Concrete: 12 percent.
  - 2. Fiber-Cement Board: 12 percent.
  - 3. Masonry (Clay and CMUs): 12 percent.
  - 4. 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. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2.
  - 2. SSPC-SP 3.
- G. 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.
- H. 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.
- I. Aluminum Substrates: Remove loose surface oxidation.

### 3.3 INSTALLATION

- 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. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. 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.
    - 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.

### 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 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Concrete Floor Sealer System, MPI INT 3.2G:
  - a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
  - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- B. CMU Substrates:
  1. Latex System, MPI INT 4.2A:
    - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
- C. Steel Substrates:
  1. Latex over Shop-Applied Quick-Drying Shop Primer System, MPI INT 5.1X: At low PEMB frame exposed to human contact up to finish ceiling systems.
    - a. Prime Coat: Primer, quick dry, for shop application, MPI #275.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.
  2. High-Performance Architectural Latex System, MPI INT 5.1R: at handrails, guardrails and steel in contact with human contact.
    - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
    - b. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
    - c. Prime Coat: Shop primer specified in Section where substrate is specified.
    - d. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
  3. Water-Based Dry-Fall System, MPI INT 5.1C, :
    - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
    - b. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
    - c. Prime Coat: Shop primer specified in Section where substrate is specified.
    - d. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.
  4. Water-Based Dry-Fall over Shop-Applied Quick-Drying Shop Primer System, MPI INT 5.1CCC:
    - a. Prime Coat: Primer, quick dry, for shop application, MPI #275.

- b. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.

D. Galvanized-Metal Substrates:

- 1. Water-Based Light-Industrial Coating System, MPI INT 5.3B:
  - a. Prime Coat: Primer, galvanized, cementitious, MPI #26.
  - b. Prime Coat: Primer, galvanized, water based, MPI #134.
  - c. Intermediate Coat: Light-industrial coating, interior, water based, matching topcoat.
  - d. Topcoat: Light-industrial coating, interior, water based, semigloss (MPI Gloss Level 5), MPI #153.
- 2. Water-Based Dry-Fall System, MPI INT 5.3H:
  - a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
  - b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.

E. Gypsum Board Substrates:

- 1. Latex over Latex Sealer System, MPI INT 9.2A:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
  - b. Prime Coat: Latex, interior, matching topcoat.
  - c. Intermediate Coat: Latex, interior, matching topcoat.
  - d. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

END OF SECTION 099124

**SECTION 101419 - DIMENSIONAL LETTER SIGNAGE****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Dimensional characters.
  - a. 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 message list, typestyles, graphic elements, and layout for each sign at least half size.
  4. Show locations of electrical service connections.
  5. Include diagrams for power, signal, and control wiring.
  6. 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 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

**1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For signs 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.

**1.8 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.

**1.9 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 014000 "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, ambient; 180 deg F, 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: Translucent face with metal 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, provide products by one of the following:
    - a. ACE Sign Systems, Inc.
    - b. ASI Sign Systems, Inc.
    - c. Gemini Signage; Gemini, Inc.
  2. Illuminated Characters: Frontlighted 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, steel, stainless steel.
  4. Material Thickness: Manufacturer's standard for size and design of character.
  5. Translucent Face Sheet: Acrylic sheet with integral color as selected by Architect from manufacturer's full range.
    - a. Sheet Thickness: Manufacturer's standard thickness for size of character.
  6. Character Height: 40".
  7. Character Depth: 2".
  8. Finishes:
    - a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
    - b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
    - c. Integral Stainless Steel Finish: As selected by Architect from full range of industry finishes.
    - d. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
    - e. Overcoat: Manufacturer's standard baked-on clear coating.
  9. Mounting: Projecting studs.

- a. Hold characters at manufacturer's recommended distance as selected by Architect Insert dimension from wall surface.

10. Typeface: Arial Bold.

### 2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure 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, spanner-head or one-way-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.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or

pre-molded to match metal wall panel profile from metal panel provider. Provide closure strips at signs above 12'-0" aff behind signs, recessed from edge 1" to prevent birds from nesting.

## 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. Stainless Steel Brackets: Factory finish brackets to match sign background finish 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. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

- D. 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. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 2.8 STAINLESS STEEL FINISHES

- 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. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 2. Directional Satin Finish: No. 4.
  - 3. Dull Satin Finish: No. 6.
  - 4. Reflective, Directional Polish: No. 7.
  - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

## 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 OF DIMENSIONAL CHARACTERS

- 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. 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. 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 101419

**SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
  - 1. Section 101300 "Directories" for building directories.
  - 2. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

**1.2 DEFINITIONS**

- A. Accessible: In accordance with the accessibility standard.

**1.3 COORDINATION**

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. 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 room-identification 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 message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For manufacturer.

- B. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

## 1.7 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. Tools: One set(s) of specialty tools for assembling signs and replacing variable sign components.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

## 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

## 1.10 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. Deterioration of embedded graphic image.
    - c. 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. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

**2.2 ROOM-IDENTIFICATION SIGNS**

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Vista System, LLC. V200-WFP 40 and WFP48.

**2.3 SIGN MATERIALS**

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure 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 nonferrous-metal or hot-dip galvanized devices unless otherwise indicated.
  - 3. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
    - b. Fastener Heads: 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 or screwed into back of sign assembly unless otherwise indicated.
    - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.



- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

## 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. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 4. 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.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
  - 1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.

## 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.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

**PART 3 - EXECUTION****3.1 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. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls in according to the accessibility standard.
- C. 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. 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.
  - 3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
  - 4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

**3.2 ADJUSTING AND CLEANING**

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs 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.

**ROOM IDENTIFICATION PANEL SIGNAGE**

LXT Eastside Development

**SECTION 10 14 23.16**

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Permit Set 09/29/22

- 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 101423.16

**SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Phenolic-core toilet compartments.

**B. Related Requirements:**

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Section 061000 "Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments.
3. Section 092216 "Non-Structural Metal Framing" for blocking.
4. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

**1.2 COORDINATION**

- A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

**1.3 ACTION SUBMITTALS****A. Product Data.**

1. Phenolic-core toilet compartments.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

**B. Shop Drawings:**

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.
5. Show overhead support or bracing locations.

- C. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturers' standard size.

- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.
- E. Delegated Design Submittals: For grab bars mounted on toilet compartment panels, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For toilet compartments.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner 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: 10 fasteners of each size and type.

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

### PART 2 - PRODUCTS

#### 2.1 SOURCE LIMITATIONS

- A. Obtain phenolic-core toilet compartments from single source from single manufacturer.
- B. 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: 450 or less.
- C. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:

1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.
- D. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 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. American Sanitary Partition Corporation.
  2. Bobrick Washroom Equipment, Inc.
  3. Bradley Corporation.
- B. Toilet-Enclosure Style: Floor-and-ceiling anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch-thick doors and pilasters and minimum 3/4-inch-thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
- E. Urinal-Screen Construction: Matching panel construction.
- F. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- G. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- H. Brackets (Fittings):
  1. Stirrup Type: Ear or U-brackets, stainless steel.
  2. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.
- I. Phenolic Compartment Finish: One color in each room.
  1. Dark-Core Phenolic: Manufacturer's standard dark color core and edge.
    - a. Facing Sheet Color: Per drawings.

**2.3 HARDWARE AND ACCESSORIES**

- A. Door Hardware and Accessories: Manufacturer's operating hardware and accessories. Mount with through bolts.
  - 1. Hinges: Manufacturer's stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door.
  - 2. Latch and Keeper: Manufacturer's standard stainless steel, surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible.
  - 3. Coat Hook: Manufacturer's standard stainless steel combination hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories.
  - 4. Door Bumper: Manufacturer's standard stainless steel, rubber-tipped bumper at outswinging doors.
  - 5. Door Pull: Manufacturer's standard stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match 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. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

**2.5 FABRICATION**

- A. 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-and-Ceiling-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

- C. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies walls, with leveling adjustment nuts at tops and bottoms of posts.
- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet enclosures and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for toilet enclosures 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 or Screens: 1/2 inch.
    - b. Panels or Screens and Walls: 1 inch.
  - 2. Full-Height (Continuous) Brackets: Secure panels or screens 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-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels 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 in accordance with 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 102113.17

**SECTION 102123 - CUBICLE CURTAINS AND TRACK****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Cubicle-curtain support systems.
2. Cubicle curtains.

**B. Related Requirements:**

1. Section 061000 "Rough Carpentry" for supplementary wood framing and blocking for mounting items requiring anchorage.
2. Section 092216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Cubicle-curtain support systems.
2. Cubicle curtains.

**B. Product Data Submittals: For each product.**

1. For each type of curtain fabric indicated, include durability, laundry temperature limits, fade resistance, applied curtain treatments, and fire-test-response characteristics.

**C. Shop Drawings: For curtains and tracks.**

1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
2. Include details of blocking for track support.

**D. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:**

1. Curtain Fabric: Not less than 10 inches square and showing complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
2. Mesh Top: Not less than 10 inches square.

**1.3 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For curtains, tracks, and hardware to include in operation and maintenance manuals.

**1.4 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. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed for each size indicated, but no fewer than 5 units.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:
  - 1. Laundering: Launderable to a water temperature of not less than 160 deg F.
  - 2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.
    - a. Identify fabrics with appropriate markings of a qualified testing agency.

**2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AR Nelson.
  - 2. Cubicle Curtain Factory, Inc.
  - 3. Healthcare Curtains.
- B. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high.
  - 1. Track Minimum Wall Thickness: 0.050 inch.
  - 2. Finish: Clear anodized.
- C. Curtain-Track Mounting: Surface.
- D. Curtain-Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
  - 1. Surface -Track Support: Not less than 5/8-inch-square 7/8-inch-OD tube.
  - 2. End Stop: Nonremovable.

- E. Curtain Roller Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.
- F. Curtain Glide Carriers: One-piece nylon glide with chrome-plated steel nylon hook.
- G. Exposed Fasteners: Stainless steel.
- H. Concealed Fasteners: Hot-dip galvanized.

## 2.3 CUBICLE CURTAINS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Quiet Curtains
  - 2. Equal approved by Architect
- B. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
  - 1. Pattern: Per the drawings.
  - 2. Width: Per the drawings.
  - 3. Color: Per the drawings.
- C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

## 2.4 CURTAIN FABRICATION

- A. Continuous Curtain Panels:
  - 1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 2 inches of added fullness.
  - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches.
  - 3. Top Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched.
  - 4. Bottom Hem: Not less than 1 inch and not more than 1-1/2 inches wide, double thickness and single lockstitched.
  - 5. Side Hems: Not less than 1/2 inch and not more than 1-1/4 inches wide, with double turned edges, and single lockstitched.
  - 6. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

**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. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install tracks level and plumb, according to manufacturer's written instructions.
- B. For tracks of up to 20 feet in length, provide track fabricated from single, continuous length.
  - 1. Curtain-Track Mounting: Surface.
- C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
  - 1. Mechanically fasten to suspended ceiling grid with screws.
  - 2. Attach track to suspended ceiling grid with manufacturer's proprietary clip.
- D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.
- F. Cubicle Curtains: Hang curtains on each curtain track.

END OF SECTION 102123

**SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Public-use washroom accessories.
2. Private-use bathroom accessories.
3. Underlavatory guards.
4. Custodial accessories.

**B. Related Requirements:**

1. Section 088300 "Mirrors" for frameless mirrors.
2. Section 093013 "Ceramic Tiling" for ceramic toilet and bath 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:**

1. Public-use washroom accessories.
2. Private-use bathroom accessories.
3. Underlavatory guards.
4. Custodial accessories.

**B. Product Data Submittals: For each 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.
3. Include electrical characteristics.

**C. 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 warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

### 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. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
  2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.

#### 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
  2. Description: Roll-in-reserve dispenser with hinged front.
  3. Mounting: Recessed and Surface mounted.
  4. Operation: Noncontrol delivery with standard spindle.
  5. Capacity: Designed for 4-1/2- or 5-inch- 5-inch- Insert dimension diameter tissue rolls.
  6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

- C. Combination Towel (Folded) Dispenser/Waste Receptacle:

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
  2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
  3. Mounting: Surface mounted with stainless steel collar Recessed with projecting receptacle.
    - a. Designed for nominal 4-inch wall depth.
  4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
  5. Minimum Waste-Receptacle Capacity: 12 gal..
  6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  7. Liner: Reusable, vinyl waste-receptacle liner.
  8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- D. Soap Dispenser:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
  2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
  3. Mounting: Vertically oriented, surface mounted.
  4. Capacity: 40 oz.
  5. Materials: Stainless Steel.
  6. Lockset: Tumbler type.
  7. Refill Indicator: Window type.
- E. Grab Bar:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
  2. Mounting: Flanges with concealed fasteners.
  3. Material: Stainless steel, 0.05 inch thick.
    - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
  4. OD: 1-1/2 inches.
  5. Configuration and Length: As indicated on Drawings.



**F. Sanitary-Napkin Disposal Unit:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

**G. Hook:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Description: Combination hat and coat hook.
3. Mounting: Concealed.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

**2.3 PRIVATE-USE BATHROOM ACCESSORIES**

- A. Source Limitations: Obtain each type of private-use bathroom accessory from single source from single manufacturer.
- B. Refer to Public Use Restroom accessories for balance of fixtures for the Private Use Bathroom Accessories.
- C. Private-Use Shower Curtain Rod:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ASI-American Specialties, Inc.
    - b. Bobrick Washroom Equipment, Inc.
    - c. Bradley Corporation.
  2. Description: 1-inch- OD, curved rod.
  3. Configuration: As indicated on Drawings.
  4. Mounting Flanges: Exposed Insert requirements fasteners; in manufacturer's standard material and finish material and finish matching rod.
  5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  6. Features: Integral chrome-plated brass glide hooks.

**D. Private-Use Folding Shower Seat:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Configuration: L-shaped seat, designed for wheelchair access.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
5. Dimensions: 22" x 34 1.2".

**2.4 UNDERLAVATORY GUARDS****A. Underlavatory Guard:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley 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 each type of custodial accessory from single source from single manufacturer.****B. Custodial Mop and Broom Holder:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ASI-American Specialties, Inc.
  - b. Bobrick Washroom Equipment, Inc.
  - c. Bradley Corporation.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.

6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  - a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
  - b. Rod: Approximately 1/4-inch-diameter stainless steel.

## 2.6 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

## 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 in accordance with 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.
  1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

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**3.2 ADJUSTING AND CLEANING**

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

**SECTION 104413 - FIRE PROTECTION CABINETS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:****1. Fire-protection cabinets for the following:****a. Portable fire extinguisher.****B. Related Requirements:****1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets****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.****1.3 CLOSEOUT SUBMITTALS****A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.****1.4 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.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- 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 FIRE-PROTECTION CABINET**

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Guardian Fire Equipment, Inc.
    - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - c. Larsen's Manufacturing Company.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Stainless steel sheet.
- D. Semirecessed Cabinet: 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 backbend depth.
- E. Cabinet Trim Material: Stainless steel sheet.
- F. Door Material: Stainless steel sheet.
- G. Door Style: Fully glazed panel with frame.
- H. Door Glazing: Tempered float glass (clear).
  - 1. Acrylic Sheet Color:
- 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 recessed 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. 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. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
  - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
    - 1) Location: Applied to cabinet glazing.
    - 2) Application Process: Silk-screened, Decals, Pressure-sensitive vinyl letters.
    - 3) Lettering Color: Red.
    - 4) Orientation: Vertical.

K. Materials:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.
  - a. Finish: ASTM A480/A480M No. 4 directional satin finish,.
2. Tempered Float Glass: ASTM C1048, 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 thick.
  2. Fabricate door frames of one-piece construction with edges flanged.
  3. Miter and weld perimeter door frames and grind 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 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 height indicated below:
  - 1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
  - 2. Provide inside latch and lock for break-glass panels.
  - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification:
  - 1. Apply decals or vinyl lettering at locations indicated.
  - 2. Apply decals or vinyl lettering on field-painted fire-protection cabinets after painting is complete.



**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 104413

**SECTION 104416 - FIRE EXTINGUISHERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
  - 1. Section 104413 "Fire Protection Cabinets."

**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.

**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 when testing interval required by NFPA 10 is within the warranty period.
  - 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, provide products by the following:
    - a. Guardian Fire Equipment, Inc.
    - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - c. Larsen's Manufacturing Company.
  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. Pressurized, AFFF-Foam Type: UL-rated 2-A:10-B, 1.6-gal. nominal capacity, with AFFF foam in stainless steel container; with pressure-indicating gage.

### 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 black baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Guardian Fire Equipment, Inc.
    - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - c. Larsen's Manufacturing Company.
  2. 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.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
  1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

**SECTION 113013 - RESIDENTIAL APPLIANCES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Refrigeration appliances.

**B. Related Requirements:**

1. Section 224100 "Residential Plumbing Fixtures" for kitchen sinks, dishwasher air-gap fittings, waste (garbage) disposers, and instant hot-water dispensers.

**1.2 ALLOWANCES****1.3 ACTION SUBMITTALS****A. Product Data:**

1. Refrigeration appliances.

**B. Product Data Submittals: For each product.**

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

**1.4 INFORMATIONAL SUBMITTALS****1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

**1.6 WARRANTY**

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:

1. Warranty Period: Five years from date of Substantial Completion.

- B. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Refrigerator/Freezer, Freezer, and Ice maker, Sealed System: Full warranty, including parts and labor, for on-site service on the product.
  - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
  - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.
- D. Dishwasher: Full warranty, including parts and labor, for on-site service on the product.
  - 1. Warranty Period for Deterioration of Tub and Metal Door Liner: Five years from date of Substantial Completion.
  - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of residential appliance from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

### 2.3 COOKING APPLIANCES

- A. Microwave Oven:
  - 1. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
    - a. GE Appliances; Haier Group.
    - b. Jennair; Whirlpool Corporation.
    - c. Kenmore; Transformco SR Brands LLC.
    - d. KitchenAid; Whirlpool Corporation.

- e. LG Electronics USA, Inc.; LG Electronics Inc.
- f. Maytag; Whirlpool Corporation.
- g. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
- h. Sharp Electronics Corp.
- i. Whirlpool Corporation.
- 2. Mounting: Undercabinet.
- 3. Type: Conventional.
- 4. Dimensions:
  - a. Width: As indicated on Drawings.
  - b. Depth: As indicated on Drawings.
  - c. Height: As indicated on Drawings.
- 5. Capacity: 1.2 cu. Ft.
- 6. Oven Door: Door with observation window and pushbutton latch release.
- 7. Microwave Power Rating: Manufacturer's standard.
- 8. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
- 9. Controls: Digital panel controls and timer display.
- 10. Material: Manufacturer's standard.
  - a. Color/Finish: Stainless Steel.

## 2.4 REFRIGERATION APPLIANCES

- A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Frigidaire.
    - b. GE Appliances; Haier Group.
    - c. Jennair; Whirlpool Corporation.
    - d. Kenmore; Transformco SR Brands LLC.
    - e. KitchenAid; Whirlpool Corporation.
    - f. LG Electronics USA, Inc.; LG Electronics Inc.
    - g. Maytag; Whirlpool Corporation.
    - h. Whirlpool Corporation.
  - 2. Type: Freestanding.
  - 3. Dimensions:
    - a. Width: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
    - c. Height: As indicated on Drawings.
  - 4. Storage Capacity:
    - a. Refrigeration Compartment Volume: 16.2 cu. ft..
    - b. Freezer Volume: 7.1 cu. ft..

- c. Shelf Area: Three adjustable glass shelves,.
  - 5. General Features:
    - a. Door Configuration: Overlay.
    - b. Built-in water-filtration system.
    - c. Dual refrigeration systems.
  - 6. Refrigerator Features:
    - a. Interior light in refrigeration compartment.
    - b. Compartment Storage: vegetable crisper and meat compartment.
    - c. Door Storage: Modular compartments.
    - d. Temperature-controlled meat/deli bin.
    - e. .
  - 7. Freezer Features: Two freezer compartment(s) with door(s) configured as pull-out drawer(s).
    - a. Automatic defrost.
    - b. Interior light in freezer compartment.
    - c. Automatic icemaker and storage bin.
  - 8. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
  - 9. Front Panel(s): Stainless steel.
    - a. Panel Color: Stainless Steel.
  - 10. Appliance Color/Finish: Stainless steel.
- B. Icemaker:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Appliances; Haier Group.
    - b. Jennair; Whirlpool Corporation.
    - c. KitchenAid; Whirlpool Corporation.
    - d. Maytag; Whirlpool Corporation.
    - e. Viking Range, LLC; Middleby Corporation.
    - f. Whirlpool Corporation.
    - g. Manitowoc Ice
  - 2. Type: Freestanding.
  - 3. Dimensions:
    - a. Width: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
    - c. Height: As indicated on Drawings.
  - 4. Ice Capacity:



- a. Production: 550 lb per day.
  - b. Storage: 543 lb.
5. Features:
- a. Door Configuration: Overlay.
  - b. Automatic defrost.
  - c. Automatic shutoff.
  - d. Defrost drain.
  - e. .
6. Front Panel: Manufacturer's standard.
- a. Panel Color: Stainless Steel.
7. Appliance Color/Finish: Stainless steel.

## 2.5 CLEANING APPLIANCES

### A. Dishwasher Insert drawing designation: Complying with AHAM DW-1.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bosch US; BSH Home Appliances Corporation.
  - b. Frigidaire.
  - c. GE Appliances; Haier Group.
  - d. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
  - e. Whirlpool Corporation.
- 2. Type: Built-in undercounter.
- 3. Dimensions:
  - a. Width: As indicated on Drawings.
  - b. Depth: As indicated on Drawings.
  - c. Height: As indicated on Drawings.
- 4. Capacity:
  - a. International Place Settings of China: 15.
  - b. Water Consumption for Full Load: 9.5 liters per cycle.
- 5. Sound Level: Maximum 42 dB.
- 6. Tub and Door Liner: Manufacturer's standard with sealed detergent and automatic rinsing-aid dispensers.
- 7. Rack System: Nylon or PVC-coated sliding dish racks, with removable cutlery basket.
- 8. Controls: Touch-pad Rotary-dial Insert description controls with four wash cycles and hot-air and heat-off drying cycle options.
- 9. Features:
  - a. Waste food disposer.

- b. Self-cleaning food-filter system.
  - c. Hot-water booster heater for 140 deg F wash water with incoming water at 100 deg F.
  - d. Lock-out feature.
  - e. Half-load option.
  - f. Delay-wash option.
  - g. Digital display panel.
  - h. Water softener.
  - i. Soil-sensing water use control system.
- 10. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
- 11. Front Panel: Stainless steel.
- 12. Appliance Color/Finish: Stainless steel.
- B. Clothes Washer: Complying with AHAM HLW-1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Appliances; Haier Group.
    - b. LG Electronics USA, Inc.; LG Electronics Inc.
    - c. Maytag; Whirlpool Corporation.
    - d. Speed Queen
  - 2. Type: Freestanding, top-loading unit.
  - 3. Dimensions:
    - a. Width: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
    - c. Height: As indicated on Drawings.
  - 4. Drum: Perforated stainless steel.
    - a. Capacity: 3.2 cu. ft..
  - 5. Controls: Rotary-dial controls for water-fill levels, wash/rinse water temperatures, and variable-speed and fabric selectors.
    - a. Wash Cycles: Six wash cycles, including regular, delicate, and permanent press.
    - b. Wash Temperatures: Three settings.
    - c. Speed Combinations: Two.
  - 6. Electrical Power: 120 V, 60 Hz, 1 phase, 15 A.
  - 7. Motor: Manufacturer's standard with built-in overload protector.
  - 8. Features:
    - a. Agitator: Center spindle.
    - b. Self-cleaning lint filter.
    - c. Unbalanced-load compensator.
    - d. Inlet Hoses: Minimum length 60 inches.

- e. Drain Hoses: Minimum length 48 inches.
  - f. Self-leveling legs.
  - g. Automatic dispenser for bleach fabric softener and detergent.
  - h. Spin-cycle safety switch.
  - i. End-of-cycle signal.
  - j. Extra-rinse option.
  - k. Delay-wash option.
  - l. Electronic temperature control.
  - m. Water levels automatically set.
  - n. Pedestal: 8-inch-high laundry pedestal with storage drawer, matching appliance finish.
9. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
10. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
11. Appliance Finish: Enamel.
- a. Color: White.
12. Front-Panel Finish: Manufacturer's standard.
- a. Panel Color: White or Black.
- C. Clothes Dryer: Complying with AHAM HLD-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. GE Appliances; Haier Group.
  - b. LG Electronics USA, Inc.; LG Electronics Inc.
  - c. Maytag; Whirlpool Corporation.
  - d. Speed Queen
2. Type: Freestanding, frontloading, electric unit.
3. Dimensions:
- a. Width: As indicated on Drawings.
  - b. Depth: As indicated on Drawings.
  - c. Height: As indicated on Drawings.
4. Drum: Perforated porcelain-enameled steel.
- a. Capacity: 7.0 cu. ft..
5. Controls: Rotary-dial controls for drying cycle, temperatures, and fabric selectors.
6. Electric-Dryer Power: 240 V, 60 Hz, 1 phase, 30 A.
7. Features:
- a. Removable lint filter.
  - b. Electronic temperature and moisture-level-sensor controls.
  - c. End-of-cycle signal.

- d. Interior drum light.
  - e. Self-leveling legs.
  - f. Antibacterial cycle.
  - g. Auxiliary drying rack.
  - h. Built-in electrical power fuse.
  - i. Pedestal: 8-inch-high laundry pedestal with storage drawer, matching appliance finish.
- 8. Appliance Finish: Enamel.
  - a. Color: White.
- 9. Front-Panel Finish: Manufacturer's standard.
  - a. Panel Color: White or Black.

## 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113013

**SECTION 115213 - PROJECTION SCREENS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Manually operated, front-projection screens.
2. Electrically operated, front-projection screens.

**B. Related Requirements:**

1. Section 061000 "Rough Carpentry" for wood backing for screen installation.

**1.2 DEFINITIONS**

- A. ALR: Ambient-light rejection; for specular reflective viewing surfaces, measured as the percentage of ambient light striking the viewing surface that has equal angles of incidence and reflection.
- B. Gain: Ratio of light reflected from viewing-surface material to that reflected perpendicularly from a magnesium carbonate surface as determined in accordance with SMPTE RP 94.
- C. Half-Gain Angle: The angle, measured from the axis of the viewing surface to the most central position on a perpendicular plane through the horizontal centerline of the viewing surface, where the gain is half of the peak gain.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show layouts and types of front-projection screens. Include the following:
- C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.
- D. Product Schedule: For front-projection screens.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For front-projection screens to include in maintenance manuals.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Environmental Limitations: Do not deliver front-projection screens until spaces are enclosed and weathertight, wet-work in installation spaces is complete and dry, and temporary or

permanent HVAC system is operating and maintaining ambient temperature and humidity conditions planned for building occupants during the remainder of the construction period.

- B. Store front-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

## 1.6 COORDINATION

- A. Coordinate layout and installation of front-projection screens with adjacent construction, including HVAC system components, and partitions.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Source Limitations for Projection Screens: Obtain front-projection screens from single manufacturer. Obtain viewing surfaces and accessories, including mounting hardware, from screen manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Viewing-Surface and Masking Materials:
  - 1. Mildew-Resistance Rating: Zero or 1 when tested in accordance with ASTM G21.
  - 2. Flame Resistance: Passes NFPA 701.
  - 3. Flame-Spread Index: Not greater than 75 when tested in accordance with ASTM E84.

### 2.3 FRONT-PROJECTION SCREENS

- A. General Requirements: Manufacturer's standard spring-roller-operated units, consisting of case, flexible screen, mounting accessories, and other components necessary for a complete installation.
  - 1. Screen Mounting: Top edge securely anchored to a rigid steel roller; bottom edge formed into a pocket holding a tubular metal slat, with ends of slat protected by plastic caps, and with a saddle and pull attached to slat by screws.
- B. Fixed Screen: Unit with free-hanging screen; with screen case fabricated from formed-steel sheet or aluminum extrusions with manufacturer's standard finish and matching end caps.
  - 1. Surface-Mounting Configuration: Mounted using manufacturer's standard fix screen system.
  - 2. Matte Viewing Surface: White, 1.0 minimum peak gain and 60-degree minimum half-gain angle.
  - 3. Seams: Where height of viewing surface exceeds maximum height without seams, locate horizontal seam with full-width material at top of viewing surface.

4. Edge Treatment: White
5. Size of Viewing Surface: As indicated in schedule on Drawings.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Install front-projection screens at locations indicated on Drawings to comply with screen manufacturer's written instructions.
- B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor them to supporting substrate in a manner that produces a smoothly operating screen that, when lowered, has flat viewing surface and plumb vertical edges.
  1. Test electrically operated units to verify that screen controls, limit switches, closures, and other operating components are in optimum functioning condition.
  2. Test manually operated units to verify that screen-operating components are in optimum functioning condition.

END OF SECTION 115213



**SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Plastic-laminate-clad countertops.
2. Fire-retardant-treated materials.
3. Accessories.

**1.2 ACTION SUBMITTALS****A. Product Data:**

1. Plastic-laminate-clad countertops.
2. Fire-retardant-treated materials.
3. Accessories.

**B. Product Data Submittals: For each product.**

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

**C. 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.

**D. Samples for Verification: As follows:**

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.
2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data: For Installer & fabricator.****B. Product Certificates: For the following:**

1. Composite wood products.

2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.
4. Adhesives.

C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

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.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: AWI's Quality Certification Program accredited participant.

#### 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 with Humidity Control: 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 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.

### 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: ISO 4586-3, Grade HGS.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Formica Corporation.
    - b. Laminart LLC.
    - c. Arborite
    - d. Wilsonart LLC.
- 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. Match Architect's sample.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- F. Core Material: Fire-retardant-treated plywood or Fire-retardant particleboard or Fire-retardant MDF.
- G. Core Material at Sinks: Particleboard made with exterior glue or MDF made with exterior glue or exterior-grade plywood.
- H. Core Thickness: 3/4 inch.
1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
- I. Backer Sheet: Provide plastic-laminate backer sheet, ISO 4586-3, grade to match exposed surface, on underside of countertop substrate.
- J. Paper Backing: Provide paper backing 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. Particleboard: ANSI A208.1, Grade M-2.
  3. Softwood Plywood: DOC PS 1.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced quality 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 and Plywood: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, 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 beyond the centerline of the burners at any time during the test.
1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
  2. For items indicated to receive a stained or natural transparent finish, use organic resin chemical formulation.
  3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
  4. Mill lumber before treatment and implement 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 exposed treated woodwork.
- C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less when tested in accordance with ASTM E84.
1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
  2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of

elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.

- D. Fire-Retardant MDF: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less in accordance with ASTM E84.

## 2.4 ACCESSORIES

- A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Outside Diameter: 2 inches.
  - 2. Color: White

## 2.5 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.6 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:
  - 1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- C. 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.
- D. 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. Provide cutouts for 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.
  - 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 of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with 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. 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. 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 variation from a straight, level plane.
  - 2. Secure backsplashes 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 o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

**SECTION 123661.16 - 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.
5. Solid surface material sinks.

**B. Related Requirements:**

1. Section 224100 "Residential Plumbing Fixtures" for non-integral sinks and plumbing fittings.

**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 Initial Selection:** For each type of material exposed to view.**D. Samples for Verification:** For the following products:

1. Countertop material, 6 inches square.

**1.3 INFORMATIONAL SUBMITTALS****A. Qualification Data:** For fabricator.**1.4 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.



**1.5 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.

**1.6 FIELD CONDITIONS**

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

**1.7 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 ISFA 2-01.
  - 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. Avonite Surfaces; a Brand of Aristech Surfaces LLC.
    - b. DuPont; DuPont de Nemours, Inc.
    - c. Formica Corporation.
  - 2. Type: Provide Standard type or Veneer type made from material complying with requirements for Standard type, as indicated unless Special Purpose type is indicated.
  - 3. Colors and Patterns: Match Architect's samples.
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

**2.2 FABRICATION**

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."
  - 1. Grade: Custom.

- B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops:

1. 1/4-inch-thick, solid surface material laminated to 3/4-inch-thick particleboard with exposed edges faced with 1/4-inch-thick, solid surface material.

D. Backsplashes: 1/2-inch- thick, solid surface material.

E. 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.

F. Joints:

1. Fabricate countertops without joints.
2. Fabricate countertops in sections for joining in field.
  - a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
  - b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

G. 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 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 079200 "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, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. 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.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
  - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- 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. Predrill 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."

**SOLID SURFACE COUNTERTOPS**

LXT Eastside Development

**SECTION 12 36 61.16**

Project #47732472

Permit Set 09/29/22

END OF SECTION 123661.16

**SECTION 133419 - METAL BUILDING SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Metal soffit panels.
5. Thermal insulation.
6. Accessories.

**B. Related Requirements:**

1. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface.
2. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.

**1.2 DEFINITIONS**

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

**1.3 COORDINATION**

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

**1.4 PREINSTALLATION MEETINGS****A. Preinstallation Conference: Conduct conference at Project site.**

1. Review methods and procedures related to metal building systems including, but not limited to, the following:
  - a. Condition of foundations and other preparatory work performed by other trades.
  - b. Structural load limitations.

- c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
  - d. Required tests, inspections, and certifications.
  - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
- 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
  - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
  - b. Structural limitations of purlins and rafters during and after roofing.
  - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
  - d. Temporary protection requirements for metal roof panel assembly during and after installation.
  - e. Roof observation and repair after metal roof panel installation.
- 3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
  - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
  - b. Structural limitations of girts and columns during and after wall panel installation.
  - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
  - d. Temporary protection requirements for metal wall panel assembly during and after installation.
  - e. Wall observation and repair after metal wall panel installation.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Metal roof panels.
    - b. Metal soffit panels.
    - c. Thermal insulation and vapor-retarder facings.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
  - 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.

2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
  3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
    - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
    - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
    - c. Show translucent panels.
  4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
    - a. Flashing and trim.
    - b. Gutters.
    - c. Downspouts.
    - d. Service walkways.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For the following products:
1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
  2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
  3. Vapor-Retarder Facings: Nominal 6-inch-square Samples.
  4. Windows: Full-size, nominal 12-inch-long frame Samples showing typical profile.
  5. Accessories: Nominal 12-inch-long Samples for each type of accessory.
- E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
  2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- F. Delegated Design Submittals: For metal building systems.
1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.6 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For erector & manufacturer.
- B. Welding certificates.
- C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
  - 1. Name and location of Project.
  - 2. Order number.
  - 3. Name of manufacturer.
  - 4. Name of Contractor.
  - 5. Building dimensions including width, length, height, and roof slope.
  - 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
  - 7. Governing building code and year of edition.
  - 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
  - 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
  - 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:
  - 1. Structural steel including chemical and physical properties.
  - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
  - 4. Shop primers.
  - 5. Nonshrink grout.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranties: For special warranties.

**1.7 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

**1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer.



1. Accreditation: Manufacturer's facility accredited according to IAS AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
  2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- 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, "Structural Welding Code - Sheet Steel."
- D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, 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. Protect foam-plastic insulation as follows:
1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
  3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

#### 1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

**1.11 WARRANTY**

- A. Special Warranty on Metal Panel Finishes: 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 D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 25 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
  - 2. Nucor Building Systems; a Nucor company.
  - 3. Heavy Structures a division of BlueScope Buildings North America, Inc
  - 4. J&M Steel
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

**2.2 SYSTEM DESCRIPTION**

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
  - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing:

1. Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and partially inset-framed girts.
- E. Eave Height: 42'-0".
- F. Bay Spacing: As determined by manufacturer 21'-4".
- G. Roof Slope: 1/4 inch per 12 inches.
- H. Roof System: Manufacturer's standard standing-seam, trapezoidal-rib, metal roof panels.
  1. Liner Panels: Tapered rib.
- I. Exterior Wall System: Manufacturer's standard concealed-fastener, tapered-rib, concealed-fastener, flat-profile, & concealed-fastener, flat-profile stucco finish metal wall panels.
  1. Liner Panels: Tapered rib.

### 2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
  1. Design Loads: As indicated on Drawings.
  2. Deflection and Drift Limits:
    - a. Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
    - b. No greater than the following:
      - 1) Primary Framing: Vertical deflection of 1/180 of the span.
      - 2) Purlins: Vertical deflection of 1/150 of the span.
      - 3) Girts: Horizontal deflection of **1/120** of the span.
      - 4) Metal Roof Panels: Vertical deflection of **1/180** of the span.
      - 5) Metal Wall Panels: Horizontal deflection of **1/120** of the span.
      - 6) Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
      - 7) Lateral Drift: Maximum of **1/240** of the building height for service level wind loads (10 year mean return period).

- C. Seismic Performance: As indicated on Drawings.
- 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: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire-Resistance Ratings: Where assemblies are indicated to have a fire-resistance rating, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E119 or ASTM E108 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory," FM Global's "Approval Guide," or from the listings of another qualified testing agency.
- F. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- G. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
  - 1. Wind Loads: As indicated on Drawings.
- H. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- I. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- J. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- K. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- L. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
  - 1. Uplift Rating: UL 90.

- M. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
  - 1. Fire/Windstorm Classification: Class 1A- 105.
  - 2. Hail Resistance: VSH.
- N. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- O. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:
  - 1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
  - 2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.
- P. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:
  - 1. Roof:
    - a. U-Factor: .047
    - b. R-Value: R30 min
  - 2. Walls:
    - a. Hangar and lean space with girt walls.
      - 1) U-Factor: .0909
      - 2) R-Value: R11 min
    - b. Terminal and School spaces with metal stud walls.
      - 1) U-Factor: .0526
      - 2) R-Value: R19 min

## 2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
    - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
  2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  3. Frame Configuration: Multiple gable.
  4. Exterior Column: Tapered.
  5. Rafter: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, pre-painted with coil coating, to comply with the following:
1. Purlins:
    - a. C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.
  2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.
  3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
  4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
  5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
  6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
  7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
  9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Canopy Framing: Manufacturer's standard structural-framing system, designed to withstand required loads; fabricated from shop-welded, built-up steel plates or structural-steel shapes.

Provide frames with attachment plates and splice members, factory drilled for field-bolted assembly.

1. Type: Straight-beam, eave type.

H. Bracing: Provide adjustable wind bracing using any method as follows:

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
2. Cable: ASTM A475, minimum 1/4-inch-diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
5. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

I. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

J. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
  - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
  - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.

9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
    - a. Finish: Plain.
  10. High-Strength Bolts, Nuts, and Washers, Grade A325: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
    - a. Finish: Plain.
  11. High-Strength Bolts, Nuts, and Washers, Grade A490: ASTM F3125/F3125M, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  12. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.
    - a. Finish: Plain.
  13. Unheaded Anchor Rods: ASTM F1554, Grade 36 or 55.
    - a. Configuration: Straight.
    - b. Nuts: ASTM A563 heavy-hex carbon steel.
    - c. Plate Washers: ASTM A36/A36M carbon steel.
    - d. Washers: ASTM F436 hardened carbon steel.
    - e. Finish: Plain.
  14. Headed Anchor Rods: ASTM F1554, Grade 36 or 55.
    - a. Configuration: Straight.
    - b. Nuts: ASTM A563 heavy-hex carbon steel.
    - c. Plate Washers: ASTM A36/A36M carbon steel.
    - d. Washers: ASTM F436 hardened carbon steel.
    - e. Finish: Plain.
  15. Threaded Rods: ASTM A36/A36M.
    - a. Nuts: ASTM A563 heavy-hex carbon steel.
    - b. Washers: ASTM F436 hardened carbon steel.
    - c. Finish: Plain.
- K. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
1. Clean and prepare in accordance with SSPC-SP2.
  2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.



- a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

## 2.5 METAL ROOF PANELS

- A. Standing-Seam, Trapezoidal-Rib, Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
  1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Exterior Finish: Two-coat fluoropolymer.
    - b. Color: Per the drawings.
  2. Clips: One-piece fixed to accommodate thermal movement.
  3. Joint Type: Mechanically seamed.
  4. Panel Coverage: 24 inches.
  5. Panel Height: 2 inches.
  6. Uplift Rating: UL 90.
- B. Finishes:
  1. Exposed Coil-Coated Finish:
    - a. 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.

## 2.6 METAL WALL PANELS

- A. Concealed-Fastener Wall Panels:
  1. As specified in Section 074213.14 "Formed Metal Wall Panels."
- B. Flush-Profile, Metal Liner Panels:
  1. As specified in Section 074213.14 "Formed Metal Wall Panels."

**2.7 METAL SOFFIT PANELS**

- A. General: Provide factory-formed 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. Concealed-Fastener, Flush-Profile, Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch-wide flange for attaching interior finish; 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.
  - 1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Pre-painted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: Refer to drawings.
  - 2. Panel Coverage: 12 inches.
  - 3. Panel Height: 1 inch.

**2.8 THERMAL INSULATION**

- A. Faced Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- B. Unfaced Metal Building Insulation: ASTM C991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.
- C. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- D. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Lamtec Corporation.
  - 2. Composition:
    - a. White polypropylene film facing and fiberglass-polyester-blend fabric backing.
- E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

**2.9 PERSONNEL DOORS AND FRAMES****A. Swinging Personnel Doors and Frames:**

1. As specified in Section 081113 "Hollow Metal Doors and Frames."

**2.10 WINDOWS****A. Aluminum Windows:**

1. As specified in Section 085113 "Aluminum Windows."

**B. Glazing: Comply with requirements specified in Section 088000 "Glazing."****2.11 TRANSLUCENT PANELS****A. As specified in Section 084523 "Fiberglass Sandwich Panel Assemblies."****2.12 HANGAR DOORS****A. As specified in Section 083416 "Hangar Doors."****B. Coordinate with hangar door provider to provide perpendicular members at approximately 10'-0" o/c, to receive top door guides. Coordinate with the hangar door provider that the perpendicular members will be at the proper elevation and within the tolerance specified for the bottom rails.****2.13 ACCESSORIES****A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.**

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.

**B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.**

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Clips: Manufacturer's standard, formed from stainless steel sheet, designed to withstand negative-load requirements.

3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless steel sheet or nylon-coated aluminum sheet.
  4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
  7. Closures: Provide closures at eaves and rakes, fabricated of same material as metal panels.
  8. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  9. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished per drawings
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
- D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match roof fascia and rake trim per drawings. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
  2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- G. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

2. Fasteners for Metal Roof Panels:
  - a. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
  - b. Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
3. Fasteners for Metal Wall Panels:
  - a. Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
4. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
5. Blind Fasteners: High-strength aluminum or stainless steel rivets.
6. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
7. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
8. Metal Panel Sealants:
  - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
  - b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

## 2.14 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
  1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members to be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
  1. Make shop connections by welding or by using high-strength bolts.

2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
  3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
  4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
  5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
1. Make shop connections by welding or by using non-high-strength bolts.
  2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

## 2.15 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
    - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive

structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

### 3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing 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. 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.
  3. 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.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. 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 will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-

nuttet anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
  - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
  1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  2. Locate and space wall girts to suit openings such as doors and windows.
  3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
  1. Tighten rod and cable bracing to avoid sag.
  2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

### 3.4 METAL PANEL INSTALLATION, GENERAL

- A. 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. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
  1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.



1. Install metal panels perpendicular to structural supports unless otherwise indicated.
  2. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  3. Locate and space fastenings in uniform vertical and horizontal alignment.
  4. Locate metal panel splices over structural supports with end laps in alignment.
  5. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

### 3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
  2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.

4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
  5. Provide metal closures at peaks rake edges rake walls and each side of ridge caps.
- C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.
1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
  2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
  3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
  4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

### 3.6 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

### 3.7 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
  2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
  3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
1. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.

- a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
  1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- D. Board Wall Insulation: Extend board insulation in thickness indicated to cover entire wall. Hold in place by metal wall panels fastened to secondary framing. Comply with manufacturers' written instructions.
  1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

### 3.8 ACCESSORY INSTALLATION

- A. General: 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 roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. 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. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  1. Install exposed flashing and trim that is without excessive oil-canning, 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 result in waterproof and weather-resistant performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
  - 1. Tie downspouts to underground drainage system indicated.
- E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

### 3.9 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform field quality control special inspections and to submit reports.
  - 1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector'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.
    - d. Radiographic Inspection: ASTM E 94.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.10 ADJUSTING

### 3.11 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting:

1. After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing[, **bearing plates**,] and accessories.
    - a. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
    - b. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
  2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 13 34 19

SECTION 142123.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Machine-room-less electric traction elevators.

B. Related Requirements:

1. Section 011000 "Summary" for purchase contract for elevators negotiated by Owner and assigned to Contractor.
2. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
3. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
4. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
5. Section 051200 "Structural Steel Framing" for the following:
  - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
  - b. Divider beams.
  - c. Hoist beams.
  - d. Structural-steel shapes for subsills.
6. Section 055000 "Metal Fabrications" for the following:
  - a. Attachment plates and angle brackets for supporting guide-rail brackets.
  - b. Divider beams.
  - c. Hoist beams.
  - d. Structural-steel shapes for subsills.
  - e. Pit ladders.
  - f. Cants made from steel sheet in hoistways.
7. Section 093013 "Ceramic Tiling" for finish flooring in elevator cars.
8. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
9. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cable for telephone service for elevators.
10. Section 284621.11 "Addressable Fire-Alarm Systems" for smoke detectors in elevator lobbies to initiate emergency recall operation, for heat detectors in shafts and machine rooms to disconnect power from elevator equipment before or on sprinkler activation, and for connection to elevator controllers.

1.2 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

- 1. Machine-room-less electric traction elevators.

B. Product Data Submittals: For each 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.

C. 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.
- 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

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, 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, in accordance with ASME A17.1/CSA B44.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal:

1. 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: 2 year(s) from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 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.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7 and shall comply with elevator seismic requirements in ASME A17.1/CSA B44.
  - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
  - 2. Project Seismic Design Category: B.
  - 3. Elevator Component Importance Factor: 1.0.
  - 4. Design earthquake spectral response acceleration short period (Sds) for Project is .35.
  - 5. Provide earthquake equipment required by ASME A17.1/CSA B44.
  - 6. Provide seismic switch required by ASCE/SEI 7.

## 2.2 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. Elevator Number(s): Insert elevator number(s) as indicated on Drawings.
  - 2. Emergency Elevator Number(s): Insert elevator number(s) as indicated on Drawings.
  - 3. Rated Load: 2500 lb.
  - 4. Rated Speed: 150 fpm.
  - 5. Operation System: Selective-collective automatic operation.
  - 6. Auxiliary Operations:
    - a. Battery-powered lowering.
    - b. Automatic operation of lights and ventilation fans.
  - 7. Car Enclosures:
    - a. Inside Width: Not less than 80 inches from side wall to side wall.
    - b. Inside Depth: Not less than 53 inches from back wall to front wall (return panels).
    - c. Inside Height: Not less than 93 inches to underside of ceiling.
    - d. Front Walls (Return Panels): Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
    - e. Car Fixtures: Polished stainless steel, ASTM A480/A480M, No. 8 finish.
    - f. Side and Rear Wall Panels: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
    - g. Reveals: Black.
    - h. Door Faces (Interior): Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
    - i. Door Sills: Aluminum.
    - j. Ceiling: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
    - k. Handrails: 1/2 by 2 inches rectangular satin stainless steel, at sides and rear of car.
    - l. Floor recessed and prepared to receive ceramic tile (specified in Section 093013 "Ceramic Tiling").
    - m. Floor Thickness, Including Setting Materials: 5/8 inch above plywood subfloor.

8. Hoistway Entrances:
  - a. Width: 42 inches.
  - b. Height: 84 inches.
  - c. Type: Single-speed side sliding.
  - d. Frames: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
  - e. Doors and Transoms: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.
  - f. Sills: Aluminum.
9. Hall Fixtures: Brushed stainless steel, ASTM A480/A480M, No. 4 finish.

## 2.3 MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Otis Worldwide Corporation.
  2. Schindler Elevator Corp.
  3. 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.

## 2.4 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 in accordance with IEEE 519.
  4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. 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.
- C. 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.
- D. Car Frame and Platform: Bolted- or welded-steel units.

- E. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

## 2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Auxiliary Operations:
  - 1. 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.
  - 2. 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 may not affect emergency firefighters' service.

## 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 causes 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 sounds and doors begins to close at reduced kinetic energy.

## 2.7 CAR ENCLOSURES

- A. 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:
    - a. Exterior, C-C Plugged grade plywood, not less than 7/8-inch nominal thickness.
  - 2. Floor Finish:
    - a. Specified in Section 093013 "Ceramic Tiling"
  - 3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.

4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
7. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
8. Ceiling: Metal flush panels, with LED linear lights.
9. "Light Fixture Efficiency" and "Ventilation Fan Efficiency" subparagraphs below are requirements of the IgCC.
10. Light Fixture Efficiency: Not less than 35 lumens/W.
11. Ventilation Fan Efficiency: Not less than 3.0 cfm/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 to accommodate hoistway wall construction.
  1. Where gypsum board wall construction is indicated, frames to be self-supporting with reinforced head sections.
- B. Materials and Fabrication: Manufacturer's standards, but not less than the following:
  1. Stainless Steel Frames: Formed from stainless steel sheet.
  2. Stainless Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless steel sheet.
  3. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
  4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

## 2.9 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide 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. Hall Push-Button Stations: Provide one hall push-button station at each landing.
  1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
  2. Equip units with buttons for calling elevator and for indicating desired direction of travel.

- D. 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.
- E. 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.

## 2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Stainless Steel Bars: ASTM A276/A276M, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
- F. Aluminum Extrusions: ASTM B221, Alloy 6063.
- G. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500 or UNS No. C77600.

## 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 OF MACHINE ROOM-LESS ELECTRIC TRACTION ELEVATORS

- 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, 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 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: Comply with the following requirements for elevator used for construction purposes:
  - 1. No temporary use will be permitted without the prior written approval of the owner and architect.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

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- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION 142123.16

SECTION 210500 - 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.
1. PRODUCTS

1.5 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, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Stack-Sleeve Fittings:
1. Description: Manufactured, Dura-coated or Duco-coated 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.
    - c. Pressure Plates: Carbon steel.
    - d. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating 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 Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

- a. ESCUTCHEONS

G. 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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
4. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
5. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

H. Floor Plates:

1. Split Floor Plates: Steel with concealed hinge.

## PART 2 - EXECUTION

### 2.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops and offsets in accordance with NFPA 13 requirements for expansion and contraction compensation.

### 2.2 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 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."

## 2.3 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 grout or silicone sealant, seal space around outside of sleeves.

## 2.4 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 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- or smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

## 2.5 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.

## 2.6 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.

## 2.7 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.

## 2.8 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. Sleeves with waterstops or stack-sleeve fittings.
- 4. Interior Walls and Partitions:
  - a. Sleeves without waterstops.

## 2.9 ESCUTCHEONS APPLICATION

### A. Escutcheons for New 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, steel with polished, chrome-plated finish.
  - b. One piece, stainless steel with polished stainless steel finish.
  - c. One piece, cast brass with polished, chrome-plated finish.
  - d. One piece, stamped steel or split plate, stamped steel with concealed 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 finish.
  - b. One piece, stainless steel with polished stainless steel finish.
  - c. One piece, cast brass with polished, chrome-plated finish.
  - d. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- 5. Bare Piping at Ceiling Penetrations in Finished Spaces:
  - a. One piece, steel with polished, chrome-plated finish.
  - b. One piece, stainless steel with polished stainless steel finish.
  - c. One piece, cast brass with polished, chrome-plated finish.

- d. One piece, stamped steel or split plate, stamped steel with concealed 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 finish.
  - c. One piece, stamped steel or split plate, stamped steel with concealed 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 finish.
  - c. One piece, stamped steel or split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
  - 1. Chrome-Plated Piping: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 2. Insulated Piping: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
  - 6. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed 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 210500

# COMMON WORK RESULTS FOR FIRE SUPPRESSION

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## SECTION 210500

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**SECTION 210523 - 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. 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 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: VDGT - 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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ames Fire & Waterworks; A WATTS Brand.
  2. Milwaukee Valve Company Ltd.
  3. NIBCO INC.
  4. Victaulic Company.
- B. 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. Supervisory Switch: Internal or external.
  11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
  12. End Connections for Valves NPS 2 through NPS 2-1/2: Grooved ends.

## 2.4 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ALEUM USA.

2. Globe Fire Sprinkler Corporation.
3. Milwaukee Valve Company.

B. 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: [Bronze] [Stainless steel][ with EPDM coating].
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.5 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ALEUM USA.
2. Anvil International.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve Company; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco by Johnson Controls Company.
7. Victaulic Company.
8. Zurn Industries, LLC.

B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ALEUM USA.
2. Ames Fire & Waterworks; A WATTS Brand.
3. Anvil International.
4. FEBCO; A WATTS Brand.
5. Fire Protection Products, Inc.
6. Globe Fire Sprinkler Corporation.
7. Kennedy Valve Company; a division of McWane, Inc.
8. Matco-Norca.
9. Mueller Co.
10. NIBCO INC.
11. Reliable Automatic Sprinkler Co., Inc. (The).
12. Shurjoint; a part of Aalberts Integrated piping Systems.
13. Tyco by Johnson Controls Company.
14. United Brass Works, Inc.
15. Venus Fire Protection Ltd.
16. Victaulic Company.
17. Viking Corporation.
18. WATTS.
19. Wilson & Cousins Inc.
20. Zurn Industries, LLC.

B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Milwaukee Valve Company.
2. NIBCO INC.

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3. United Brass Works, Inc.
4. Zurn Industries, LLC.

### B. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Hammond Valve.
4. Kennedy Valve Company; a division of McWane, Inc.
5. Mueller Co.
6. NIBCO INC.
7. Victaulic Company.
8. WATTS.
9. Zurn Industries, LLC.

### B. 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: Grooved.

**2.9 NRS GATE VALVES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Clow Valve Company; a subsidiary of McWane, Inc.
3. Kennedy Valve Company; a division of McWane, Inc.
4. Mueller Co.
5. NIBCO INC.
6. Victaulic Company.
7. Zurn Industries, LLC.

B. 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. End Connections: Grooved.

**2.10 TRIM AND DRAIN VALVES**

A. Ball 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. Fire Protection Products, Inc.
  - c. Fire-End & Croker Corporation.
  - d. Flowserve Corporation.
  - e. FNW; Ferguson Enterprises, Inc.
  - f. Jomar Valve.
  - g. KITZ Corporation.
  - h. Legend Valve & Fitting, Inc.
  - i. Metso Automation USA Inc.
  - j. Milwaukee Valve Company.
  - k. NIBCO INC.
  - l. Potter Roemer LLC; a Division of Morris Group International.
  - m. Red-White Valve Corp.

- n. Tyco by Johnson Controls Company.
  - o. Victaulic Company.
  - p. WATTS.
  - q. Zurn Industries, LLC.
2. 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.

### 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 211000 "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.
  - 2. Section 211339 "Foam-Water Systems" for application of valves in AFFF piping.

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3. Section 331415 "Site Water Distribution Piping" for application of valves in fire-suppression water-service piping.
  - 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 210553 "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 210523



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**SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 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. Equipment supports.

**B. Related Requirements:**

- 1. **Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.**
- 2. **Section 210516 "Expansion Fittings and Loops for Fire-Suppression Piping" for pipe guides and anchors.**
- 3. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for vibration isolation devices **and seismic restraints.**

**1.3 ACTION SUBMITTALS**

**A. Product Data:** For each type of product.

**B. Shop Drawings:** Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

- 1. Trapeze pipe hangers.
- 2. Metal framing systems.
- 3. 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.

#### 1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 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 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression 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.**
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

#### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM 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 or stainless 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 NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

**2.4 METAL FRAMING SYSTEMS**

**A. MFMA Manufacturer Metal Framing Systems:**

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

**B. Non-MFMA Manufacturer Metal Framing Systems:**

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Pregalvanized G90.

**2.5 THERMAL HANGER-SHIELD INSERTS**

- A. Insulation-Insert Material: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

**2.6 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-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. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-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 steel.
  - 2. Outdoor Applications: Stainless steel.

**2.7 EQUIPMENT SUPPORTS**

- A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

**2.8 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 078413 "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 INSTALLATION OF HANGERS AND SUPPORTS

- A. 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.
- 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. 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. Install in accordance with approvals and listings.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.

- J. 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.
- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. 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.
- M. 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. MSS SP-58, Type 39 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. MSS SP-58, Type 40 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 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. Touchup:
  - 1. 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.
    - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.



2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in **Section 099113 "Exterior Painting," Section 099123 "Interior Painting," Section 099600 "High-Performance Coatings."**

- B. 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, 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 or stainless-steel 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. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

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SECTION 210553 - 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. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve-numbering scheme.
- D. 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 stainless steel, 0.025 inch aluminum, 0.032 inch anodized aluminum, 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. Plastic Labels for Equipment:**

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 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, 1/16 inch 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.

# IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

LXT Eastside Development

## SECTION 210553

Project #47732472  
Permit Set 09/29/23

- 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 4 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 stainless steel, 0.024 inch aluminum, 0.031 inch or anodized aluminum, 0.031 inch thick, with predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire link chain beaded 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.

## 2.6 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 Approximately 4 by 7 inches.

2. Fasteners: Brass grommet and wire Reinforced grommet and wire or string.

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. Piping Color Coding: Painting of piping is specified in **Section 099123 "Interior Painting."** **Section 099600 "High-Performance Coatings."**
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. 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.
- D. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. 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.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
  - 1. Valve-Tag Size and Shape: 1-1/2 inches (DN 38), round.
  - 2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red 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 **scheduled**.

END OF SECTION

**SECTION 210800 - COMMISSIONING OF FIRE SUPPRESSION****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section includes Cx process requirements for the following fire-suppression systems, assemblies, and equipment:
  - 1. Water-based fire-suppression systems.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. For construction checklists, comply with requirements in various Division 21 Sections specifying fire-suppression systems, system components, equipment, and products.

**1.2 DEFINITIONS**

- A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- C. IgCC: International Green Construction Code.
- D. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For fire-suppression testing technician.
- B. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Contractor, provide the following:
  - 1. Equipment/instrument identification number.
  - 2. Planned Cx application or use.
  - 3. Manufacturer, make, model, and serial number.
  - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  - 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:

- a. Instrument or tool identification number.
- b. Equipment schedule designation of equipment for which the instrument or tool is required.
- c. Manufacturer, make, model, and serial number.
- d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Suppression Testing Technician Qualifications: Technicians to perform fire-suppression Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
  1. Journey level or equivalent skill level with knowledge of fire-suppression system, electrical concepts, and building operations.
  2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration:
  1. Capable of testing and measuring performance within the specified acceptance criteria.
  2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  3. Be maintained in good repair and operating condition throughout duration of use on Project.
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. 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, shall comply with the following:
    - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
    - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
    - c. Fire-suppression system 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 Cx PROCESS****A. Perform Cx process for fire-suppression system in accordance with the following:**

1. Section 019113 "General Commissioning Requirements."
2. NFPA 3.

**3.2 CONSTRUCTION CHECKLISTS****A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3. Contractor performs the following:**

1. Review fire-suppression system preliminary construction checklists and provide written comments on Construction Checklist items where appropriate.
2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
4. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

**B. Prepare preliminary detailed construction checklists for each fire-suppression system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in NFPA 3.**

1. Submit preliminary construction checklists to CxA and Designer for review.
2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
3. Use only construction checklists marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed, and provide pertinent details and other information.

**C. Additional Systems Required to Be Commissioned:**

1. Facility fire-suppression water-distribution piping outside the building, including the following:
  - a. Fire-suppression water piping, fittings, and specialties outside the building.

- b. Hydrants and fire-department connections.
  - c. Fire-alarm devices.
  - d. Meters and meter pits.
  - e. Outdoor water-storage tanks.
  - f. Sleeves and sleeve seals.
  - g. Meters and gauges.
  - h. General-duty and specialty valves.
  - i. Hangers and supports.
  - j. Heat tracing.
  - k. Vibration isolation.
  - l. Identification.
  - m. Insulation.
2. Fire-suppression sprinkler systems, including the following:
- a. Wet-pipe sprinkler piping, fittings, sprinklers, and specialties.
  - b. Dry-pipe sprinkler piping, fittings, sprinklers, and specialties.
  - c. Pressure-maintenance pumps, motors, accessories, and controls.
  - d. Compressed-air piping, compressors, motors, accessories, and controls.
  - e. Sleeves and sleeve seals.
  - f. Meters and gauges.
  - g. General-duty and specialty valves.
  - h. Hangers and supports.
  - i. Vibration isolation.
  - j. Identification.

### 3.3 Cx TESTING PREPARATION

- A. Certify that fire-suppression systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that fire-suppression system instrumentation and control systems have been completed and calibrated, that they are operating in accordance with the Contract Documents and approved submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

### 3.4 Cx TEST CONDITIONS

- A. 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.
- B. If tests cannot be completed because of a deficiency outside the scope of the fire-suppression system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation, and schedule seasonal tests.

### 3.5 Cx TESTS COMMON TO FIRE-SUPPRESSION SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response compared to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 21 Sections specifying fire-suppression systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
1. Cx Construction Checklist verification tests.
  2. Cx Construction Checklist verification test demonstrations.

### 3.6 CONSTRUCTION CHECKLIST EXAMPLES

- A. Vibration Isolation in Fire-Suppression Systems:
1. Prerequisites: Acceptance of results of construction checklists for vibration control devices specified in **Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment."**
  2. Components to Be Tested:

- a. Vibration isolation control devices in water-based fire-suppression systems.
    - b. Support systems.
  3. Test Purpose: Evaluate effectiveness of vibration isolation control devices.
  4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness while the isolated equipment operates.
    - a. Maximum speed.
    - b. Minimum speed.
    - c. Critical speed.
  5. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- B. Supervision of Fire-Protection Valves in Water-Based Fire-Suppression Systems:
1. Prerequisites: Acceptance of results of construction checklists for valves specified in the following Sections:
    - a. Section 210523 "General-Duty Valves for Water-Based Fire Protection Piping."
    - b. Section 211000 "Water-Based Fire-Suppression Systems."
    - c. Section 284621.11 "Addressable Fire-Alarm Systems."
    - d. Section 284621.13 "Conventional Fire-Alarm Systems."
    - e. Section 331415 "Site Water Distribution Piping."
  2. Equipment and Systems to Be Tested:
    - a. Supervised valves in water-based fire-suppression systems.
    - b. Division 28 fire-detection and -alarm systems.
  3. Test Purpose: Verify generation of supervisory alarm at the fire-alarm control panel in response to activation of valve supervision device or tamper switch.
  4. Test Conditions:
    - a. Fire-alarm system operating in normal, automatic mode.
    - b. Activate valve supervision devices and tamper switches, one at a time.
  5. Acceptance Criteria: Activation of valve supervision device or tamper switch generates supervisory alarm at fire-alarm control panel.

END OF SECTION

**SECTION 211000 - 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. System control valves.
4. Fire-suppression piping specialties.
- 5.
6. Sprinklers.
7. Alarm Devices
8. Pressure Gauge

**B. Related Requirements:**

1. Section 331415 "Site Water Distribution Piping" for site fire-suppression water-service and backflow prevention devices.

**1.2 DEFINITIONS**

- A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.
- B. High-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

**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 100 psig.
    - b. Name of hydraulic program used.
    - c. Water supply information, including fire hydrant flow test data report.
  3. Submit documents and calculations signed and sealed by qualified professional engineer responsible for their preparation
  4. Include diagrams for power, signal, and control wiring.
- C. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 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 professional engineer.
- 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 qualified professional engineer.

- 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 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 Construction Manager's written permission.

## PART 2 - PRODUCTS

## 2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe 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.
- D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.
- E. Fire sprinkler system shall be designed in accordance with 2022 NFPA 409.
- F. Delegated Design: Engage a qualified professional engineer to design fire-suppression systems.

- 1. Fire-Hydrant Flow Test:

- a. Perform fire-hydrant flow test and record the following conditions:

- 1) Date: **<Insert test date>**.
    - 2) Time: **<Insert time>** [a.m.] [p.m.]
    - 3) Performed by: **<Insert operator's name>** of **<Insert firm>**.
    - 4) Location of Residual Fire Hydrant R: **<Insert location>**.
    - 5) Location of Flow Fire Hydrant F: **<Insert location>**.
    - 6) Static Pressure at Residual Fire Hydrant R: **<Insert psig>**.
    - 7) Measured Flow at Flow Fire Hydrant F: **<Insert gpm>**.
    - 8) Residual Pressure at Residual Fire Hydrant R: **<Insert 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. General Storage Areas: Ordinary Hazard, Group 1.
  - b. Offices, including Data Processing: Light Hazard.

4. Minimum Density for Automatic-Sprinkler Piping Design unless otherwise indicated on plans:
  - 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.
  - d. Aircraft hangar: 0.17 gpm/sq. ft. over 5000 sq. ft. (8.2 mm/min. over 140 sq. m) area.
  - e. Structural column protection (2 hour rating): .25 gpm/sq. ft. of column wetted area.
5. Maximum protection area per sprinkler in accordance with UL listing.
6. 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.
  - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
7. Minimum residual pressure at each hose-connection outlet is as follows:
  - a. NPS 1-1/2 Hose Connections: 65 psig.
  - b. NPS 2-1/2 Hose Connections: 100 psig.

G. 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. Engineered Light-Wall Steel Pipe: black-steel pipe, ASTM A135/A135M or ASTM A795/A795M with wall thickness less than Schedule 40. Outside dimension is to be equivalent to Schedule 40.
  - 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.
- 4. Steel Pipe Nipples: black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- 5. Steel Couplings: uncoated steel, ASTM A865/A865M, threaded.
- 6. Gray-Iron Threaded Fittings: uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
- 7. Malleable- or Ductile-Iron Unions: ASME B16.3.
- 8. Cast-Iron Flanges: ASME B16.1, Class 125.
- 9. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
    - 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.
- 10. 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.
- 11. Plain-End-Pipe Fittings:
  - a. Pressure Rating: 175 psig minimum.
  - b. Plain-End Fittings for Steel Piping: 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.
- 12. Grooved-Joint, Steel-Pipe Appurtenances:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) SPF/Anvil; an ASC Engineered Solution.
    - 2) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
    - 3) Victaulic Company.
  - b. Pressure Rating: [175 psig] [250 psig] [300 psig] minimum.
  - c. Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
  - d. 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.

## 2.4 FIRE DEPARTMENT CONNECTIONS

### A. Fire Department Connection, Flush Type:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Fire Supply.
  - b. Croker; a Division of Morris Group International.
  - c. Elkhart Brass Mfg. Co., Inc.
  - d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer LLC; a Division of Morris Group International.
  - f. Wilson & Cousins Inc.
- 2. Standard: UL 405.
- 3. 5 inch storz connection
- 4. Description: Flush, for wall mounting.
- 5. Pressure Rating: 175 psig minimum.
- 6. Body Material: Corrosion-resistant metal.
- 7. Inlets: NHS (2-1/2 inch) 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.
- 8. Caps: Brass, lugged type, with gasket and chain.
- 9. Escutcheon Plate: Rectangular, brass, wall type, with factory-cast letter markings.
- 10. Outlet: With pipe threads.
- 11. Body Style: Horizontal.
- 12. Number of Inlets: One.

13. Outlet Location: Back.
14. Escutcheon Plate Marking: AUTO SPRINKLER .
15. Finish: Rough brass.
16. Outlet Size: NPS 4.

## 2.5 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.

## 2.6 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.
  5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- 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. Branch Line Testers:
  1. Standard: UL 199.
  2. Pressure Rating: 175 psig.
  3. Body Material: Brass.
  4. Size: Same as connected piping.

5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. 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.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. 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.

G. 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.

H. Manual Air Vent/Valve:

1. Description: Ball valve that requires human intervention to vent air.
2. Body: Forged brass.
3. Ends: Threaded.
4. Minimize Size: 1/2 inch.
5. Minimum Water Working Pressure Rating: 300 psig.

I. Automatic Air Vent:



1. Description: Automatic air vent that automatically vents trapped air without human intervention. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.
4. Minimum Water Working Pressure Rating: 175 psig.

J. Automatic Air Vent Assembly:

1. Description: Automatic dual air vent assembly that automatically vents trapped air without human intervention, including Y-strainer and ball valve in a pre-piped assembly. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.
4. Minimum Water Working Pressure Rating: 175 psig.

2.7 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.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
3. Victaulic Company.
4. Viking Group Inc.

C. Standards:

1. UL 199.
2. UL 1767.
3. UL 1626.
4. FM 2000.
5. FM 2008.
6. FM 2030.

D. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

E. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: 175 psig minimum.

F. 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.
3. Standard Spray, Quick Response:
  - a. Upright.
  - b. Pendent.
  - c. Recessed pendent.
  - d. Flat, Concealed pendent.
  - e. Horizontal sidewall.
  - f. Flat, concealed horizontal sidewall.

G. Sprinkler Finishes: Chrome plated.

H. 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.

I. Sprinkler Guards and Water Shields:

1. Standard: UL 199.
2. Description: Wire cage with fastening device for attaching to sprinkler.

## 2.8 ALARM DEVICES

A. Match alarm-device material and connection types to piping and equipment materials and connection types.

B. Electrically Operated Notification Appliances:

1. Strobe/Horn:
  - a. Standard: UL 464.

- b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
- c. Voltage: 120 V ac, 60 Hz.
- d. Effective Intensity: 110 cd.
- e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
- f. 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.

C. Water-Flow Indicators:

- 1. Standard: UL 346.
- 2. Water-Flow Detector: Electrically supervised.
- 3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125 V ac and 0.25 A, 24 V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 4. Type: Paddle operated.
- 5. Pressure Rating: 250 psig.
- 6. Design Installation: Horizontal or vertical.

D. 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.

## 2.9 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.

## 2.10 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0 to 250 psig minimum.
- D. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

# 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 331415 "Site Water Distribution Piping."

### 3.3 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 210548 "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. Drain dry-type fire-suppression system piping.
  - 1. Install electric heating cables and pipe insulation on fire-suppression piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Results for Fire-Suppression Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Results for Fire-Suppression Piping."

### 3.4 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. 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.
- I. 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.
- J. 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.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- L. 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.

### 3.5 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 033000 "Cast-in-Place Concrete."
- C. Install two protective pipe bollards on sides of each fire department connection. Comply with requirements for bollards in Section 055000 "Metal Fabrications."
- D. Install automatic horizontal (ball-drip) drain valve at low points of piping for fire department connection.

### 3.6 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.

### 3.7 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 **[dry-pipe]** **[and]** **[preaction]** valves with trim sets for air supply, drain, priming level, alarm connections, ball-drip valves, pressure gauges, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air-supply piping.
    - b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14 to 60 psig adjustable range; and 175 psig maximum inlet pressure.
    - c. Install compressed-air-supply piping from building's compressed-air piping system.



3. 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.

### 3.8 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of narrow dimension of acoustical ceiling panels within tolerance of 1/2 inch. 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.

### 3.9 INSTALLATION OF NITROGEN GENERATOR WITH PURGE/VENT SYSTEM

- A. Install in accordance with manufacturer's written installation instructions.
- B. Locate purge vent/valve in accordance with manufacturer's written installation instructions.
- C. Route alarm signals in code-approved electrical conduit from nitrogen generator system control panel to the supervisory circuit of BAS.

### 3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 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. Coordinate with fire-alarm tests. Operate as required.
  - 6. Verify that equipment hose threads are same as local fire department equipment.
  - 7. 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.

### 3.12 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.

### 3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain system control valves.

### 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 or 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. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 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 10, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 and larger, to Be One of the Following:
1. 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.

### 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. Rooms with custom ceilings: Flat concealed sprinklers with factory painted cover plate to match surrounding surfaces. Spaces Subject to Freezing: Upright sprinklers, dry pendent sprinklers, and dry sidewall sprinklers as indicated.
- 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 bright chrome escutcheon.
  3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

END OF SECTION

SECTION 220010 - BASIC MECHANICAL REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Divisions 21, 22, and 23.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations.

1.3 CONTRACT DOCUMENTS

- A. All work shall be executed in accord with the requirements of national, state, and local codes, regulations, and standards applicable to the trade affected.
- B. Should any change in the Contract Documents be required to comply with the governing codes, regulations, and standards, notify the Architect-Engineer prior to the time of submitting a Bid. After entering into the Contract, the Contractor will be held liable to complete all work necessary to meet these requirements without extra cost to the Owner.
- C. Should any conflict occur in, or between, the Drawings and Specifications, the Contractor is deemed to have based his Bid on the more expensive material, equipment, product, or work, unless he shall have asked for, and obtained, a written clarification or decision in regard to the conflict from the Architect-Engineer. The written decision, in the form of Addenda to the Contract, shall be obtained prior to submission of the Bid.
- D. Work required by the Contract Documents, which exceed the minimum requirements of the governing codes, standards, and regulations shall be done as shown or specified
- E. Include payments for fees, permits, inspections, and licensing required for the Mechanical Work under this Division.
- F. Payment of assessments and charges levied by the serving utilities, relative to Mechanical Work, shall be paid by the Mechanical Contractor.
- G. Arrange for required inspections as early as possible. When possible, have all inspections at the same time.

**1.4 DRAWINGS AND MEASUREMENTS**

- A. Mechanical drawings are diagrammatic and indicate the general arrangement of systems and equipment, except when specifically dimensioned or detailed. Plumbing, piping, and ductwork plans are intended to show size, capacity, approximate location, direction, and general relationship of one work phase to another, but not the exact detail or arrangement.
- B. As the Mechanical drawings are of small scale, it is not possible to show all necessary offsets, fittings, and accessories. Examine General Construction, Mechanical, and Electrical Drawings and Specifications; obtain exact locations, measurements, levels, etc., at the site; arrange systems accordingly; and, at no additional expense to the Owner, furnish fittings, offsets, and accessories as required.
- C. Mechanical equipment layout and service clearances are associated with the Basis of Design Equipment Requirements. If Contractor chooses to select equipment from other available manufacturers, the Contractor shall be responsible to verify all chosen manufacturer's service clearance are maintained. If the chosen equipment requires system or building design modifications to obtain these clearances, the Contractor shall be fully responsible for those modifications and associated costs.

**1.5 SHOP DRAWING SUBMITTALS**

- A. Composite Drawings:
  - 1. The Contractor shall prepare composite Drawings and installation layouts when required to solve tight field conditions.
  - 2. Drawings shall consist of dimensioned plans and elevations and shall give complete information, particularly as to size and location of sleeves, inserts, attachments, openings, conduits, ducts, boxes, structural interferences, etc.
- B. Product Data:
  - 1. The purpose of submittals by Contractor's is to demonstrate to the Architect-Engineer that the Contractor understands the design concept; and that his understanding is demonstrated by indicating the equipment and materials he intends to furnish and install, and the fabrication and installation methods he intends to use.
  - 2. The Contractor shall become acquainted with the content of the submittals prior to turning the material over to the Architect-Engineer. The Contractor shall review these submittals and make necessary corrections before merely forwarding them to the Architect-Engineer.
  - 3. Do not fabricate or order products or begin work which requires submittals until approval of submittal.
  - 4. Sequentially number submittals. Revised submittals should include original number and a sequential alphabetic suffix.

5. Submit manufacturer's printed literature in original form. Any fading type of reproduction for example - a "second generation" facsimile will not be accepted.
  6. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with the contract requirements.
    - a. Provide manufacturers catalog sheets, brochures, standard diagrams, schematics, schedules, performance charts, illustrations and other standard descriptive data. Where printed literature describes items in addition to that item being submitted, the submitted item shall be clearly marked on the sheet and superfluous information shall be crossed out. Delete information which is not applicable to the Contract.
    - b. The Contractor shall supplement standard information with additional information applicable to this Contract, and indicate dimensions, clearances, performance characteristics, capacities, wiring and piping diagrams, and controls. Clearly delineate the following information:
      - 1) Applicable Contract Specification Section Numbers.
      - 2) Applicable Standards, such as ASTM or Federal specification numbers.
      - 3) Clearly mark each copy to identify pertinent product, or models. Show descriptive names of materials and equipment, classified item numbers, and locations at which materials or equipment are to be installed in the Work. Use the same reference identification as shown on Contract Drawings.
      - 4) Show physical dimensions, weights, and clearances required.
      - 5) Furnish performance curves for all pumps and fans
      - 6) Show performance data consisting of equipment capabilities, RPM, KW, pressure drops, design and operating points, pressures, temperatures, noise level curves, power characteristics and consumption; conforming as closely as possible to the test methods referenced in the plans and specifications.
      - 7) Show wiring or piping diagrams and controls.
      - 8) Identify any and all deviations from the Contract Drawings and specifications.
  7. The Contractor's stamp, initialed or signed, shall certify dimensional compatibility of the product(s) with the space in which it is intended to be used. Furthermore, it shall signify his review of the submittal(s) for compliance with Contract requirements.
- C. Reviewed Submittals: The Architect-Engineer's review of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Review will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been reviewed by the Architect-Engineer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary, and the Architect-Engineer is financially compensated for the additional review.

- D. Deviations: For submittals which include proposed deviations requested by the Contractor, the proposed deviations from the contract requirements shall be clearly identified. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal.

1.6 QUALITY OF WORK

- A. All work shall be of the best quality free from defects in workmanship, materials, and performance.

1.7 DELIVERY AND RECEIVING

- A. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with work and conditions at site, work of other contractors, limitations on storage space, availability of personnel and handling equipment.
- C. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.

1.8 STORAGE, GENERAL

- A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
- B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.
- C. Protect products from dirt, including construction dust. Products left exposed to dirt or dust must be thoroughly cleaned to the satisfaction of the Engineer prior to installation.

1.9 ENCLOSED STORAGE

- A. Store products, subject to damage by the elements, in substantial weather tight enclosures.
- B. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
- C. Provide humidity control and ventilation for sensitive products as required by manufacturer's instructions.

- D. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

**1.10 EXTERIOR STORAGE**

- A. Provide substantial platforms, blocking, or skids, to support fabricated products above ground; slope to provide drainage. Protect products from soiling and staining.
- B. For products subject to discoloration or deterioration from exposure to the elements, cover with impervious sheet material. Provide ventilation to avoid condensation.
- C. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet material, to prevent mixing with foreign matter.
- D. Provide surface drainage to prevent erosion and ponding of water.

**1.11 SUBSTITUTIONS**

- A. Refer to front portion of the specifications.
- B. The Owner shall be the sole and final judge as to the suitability of items substituted for those specified. Requests for substitutions shall be submitted no later than ten (10) days prior to the day of bid opening. If prior approval is not granted, equipment shall be furnished as specified or as shown on the plans.
- C. The entire cost of all changes of any type due to substitutions for materials specified shall be borne by the Contractor at no extra cost to the Owner & shall reimburse other trades of additional cost due to substitution.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents

**1.12 CHANGE ORDERS**

- A. Refer to front portion of the specifications.
- B. The Contractor shall, in no instance, commence work on, or provide materials for or make changes in, the work for this project which will require additional payment from the Owner to the Contractor until he has requested and obtained, in writing, either a signed written Change Order or a signed written notice to proceed with the extra work.
- C. Each request for approval of additional work which is to require additional payment from the Owner, or in instances where credit is to be allowed to the Owner for omission of certain work or materials, shall be accompanied by a price quotation, including a complete cost breakdown of materials, labor, overhead and profit.



**1.13 SALVAGE**

- A. Items to be salvaged by the Owner will be identified by the Owner and removed by the Contractor. Coordinate items with Owner before removal work is commenced.
- B. Items that are not salvaged by the Owner, shall be removed from the site by the Contractor. The Contractor shall coordinate salvage with the Owner.

**1.14 OPERATING AND MAINTENANCE MANUAL**

- A. Refer to front portion of the specifications and to each Section of Divisions 22 and 23.
- B. The Contractor shall furnish three (3) Operating and Maintenance Manuals to the Owner after all tests and adjustments have been completed. Final payment will not be made until this manual has been submitted and approved. In addition to the requirements of the front portion of these specifications, the manual shall include but not limited to:
  - 1. Binder: All of the above described items shall be assembled in a three-ring binder with a hard cover and durable cloth or plastic finish.
  - 2. Index: A complete index shall be included at the front of the manual.
  - 3. Name, Address and Telephone of the Manufacturer and Local Representative: Include a list of all suppliers and representatives of products supplied on the project shall be included in the manual.
  - 4. Valve List: A list of all valves with the number and function of each valve shall be included in the manual.
  - 5. V-Belt and Filter List: A list of all V-belts and filters with sizes, types and quantities required by each piece of equipment shall be included in the manual.
  - 6. Shop Drawings: One copy of each approved shop drawing shall be included in the manual.
  - 7. Manufacturers' Manuals and Parts Lists: Operating and maintenance manuals and parts lists furnished by equipment manufacturers shall be included in the manual.
  - 8. Startup and Shutdown Procedures: A written description of the procedure for starting up and shutting down each mechanical system shall be included in the manual. This description shall include motors to start, valves to open, etc., in proper sequence and location of switches, starters, push buttons and valves.
  - 9. Seasonal Changeover Procedure (if applicable): A written description of the procedures necessary for seasonal changeover from heating to cooling and vice versa shall be included in the manual.
  - 10. Manufacturers Start-up of Equipment Documentation: Documents shall include date and time of start-up, name of authorized personnel who performed start-up, any required settings and notes concerning start-up shall be included in the manual.
  - 11. State or City Tests, Approval, or Acceptance of Equipment and/or systems: This shall include date, time, name of authorized personnel and any other notes. Documentation of domestic water sterilization and equipment approved installation start-ups shall be included in the manual.

12. Reports: Include air and water balancing reports.

1.15 AS-BUILT DRAWINGS

- A. Refer to front portion of the specifications.
- B. This Contractor shall prepare as-built drawings for the various component portions of the mechanical installations. These drawings shall be furnished to the Owner after completion of the work. These drawings shall be prepared by marking up a set of contract drawings with colored pencils to show changes made during construction after the various installations have been completed.

1.16 GUARANTEE

- A. Refer to front portion of the specifications.
- B. The Contractor shall guarantee that all mechanical systems shall be free from defects in workmanship, materials and performance to specified capacities and that if such defects shall appear during a period of one year, or as specified in another section, from date of final acceptance, he will remedy such defects to the satisfaction of the Owner at no extra cost.

1.17 EXTRA MATERIALS

- A. Furnish extra materials as described in each Division 22 and 23 sections and items are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
  1. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  2. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

## **BASIC MECHANICAL REQUIREMENTS FOR PLUMBING**

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3. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
4. Coordinate noisy or loud work to be completed during non-business working hours, weekends or during designated times from Owner.
- 5.

END OF SECTION 220010

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves without waterstop.
2. Sleeves with waterstop.
3. Sleeve-seal systems.
4. Grout.
5. Silicone sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

2.2 SLEEVES WITH WATERSTOP

- A. Description: Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.3 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 20 psig minimum.
  2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Stainless steel.
  4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

**2.4 GROUT**

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

**2.5 SILICONE SEALANTS**

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
  - 1. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, T, NT: Single-component, 25, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
  - 1. Standard: ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

**PART 3 - EXECUTION**

**3.1 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. 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.
- 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- 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 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."

### 3.2 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 to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout or silicone sealant, seal the space around outside of sleeves.

### 3.3 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. Position piping in center of sleeve. Center piping in penetration, 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.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

## **SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

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1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

### **3.5 SLEEVE SCHEDULE**

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. 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.
2. Concrete Slabs above Grade:
  - a. Sleeves with waterstops.
3. Interior Partitions:
  - a. Sleeves without waterstops.

END OF SECTION

**SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Thermometers, liquid in glass, lead free.
2. Thermowells, lead free.
3. Pressure gauges, dial type, lead free.
4. Gauge attachments, lead free.
5. Test plugs, lead free.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of product.**1.3 CLOSEOUT SUBMITTALS****A. Operation and Maintenance Data:** For meters and gauges to include in operation and maintenance manuals.**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A.** All items in this Section in contact with 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.

**2.2 THERMOMETERS, LIQUID IN GLASS, LEAD FREE****A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Industrial Style:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Blue Ribbon Corp.
  - b. Flo Fab Inc.



- c. Miljoco Corporation.
  - d. Palmer Wahl Instrumentation Group.
  - e. Trerice, H. O. Co.
  - f. Weiss Instruments, Inc.
  - g. Weksler Glass Thermometer Corp.
  - h. Winters Instruments - U.S.
2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, industrial-style thermometers from single manufacturer.
  3. Standard: ASME B40.200.
  4. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
  5. Case Form: Adjustable angle unless otherwise indicated.
  6. Tube: Glass with magnifying lens and blue or red organic liquid, mercury free.
  7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
  8. Window: Glass or acrylic plastic.
  9. Stem: Aluminum and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  10. Connector: 1-1/4 inches, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
  11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

## 2.3 THERMOWELLS, LEAD FREE

### A. 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 match thermometer stem length.
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.
12. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.4 PRESSURE GAUGES, DIAL TYPE, LEAD FREE

## A. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ametek U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Blue Ribbon Corp.
  - d. Ernst Flow Industries.
  - e. Flo Fab Inc.
  - f. Marsh Bellofram.
  - g. Miljoco Corporation.
  - h. Noshok.
  - i. Palmer Wahl Instrumentation Group.
  - j. REOTEMP Instrument Corporation.
  - k. Tel-Tru Manufacturing Company.
  - l. Trerice, H. O. Co.
  - m. WATTS; A Watts Water Technologies Company.
  - n. WIKA Instrument Corporation.
  - o. Weiss Instruments, Inc.
  - p. Weksler Glass Thermometer Corp.
  - q. Winters Instruments - U.S.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free bourdon tube.
6. Pressure Connection: Lead-free 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.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass or plastic.
11. Ring: Stainless steel.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

## 2.5 GAUGE ATTACHMENTS, LEAD FREE

- A. Snubbers: ASME B40.100, lead-free brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston -type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Lead-free brass or stainless steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

**2.6 TEST PLUGS, LEAD FREE**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. IMI Flow Design, Inc.
  2. Miljoco Corporation.
  3. Nexus Valve, Inc.; Aalberts Hydronic Flow Control.
  4. Peterson Equipment Co., Inc.
  5. Trerice, H. O. Co.
  6. WATTS; A Watts Water Technologies Company.
  7. Weiss Instruments, Inc.
  8. Weksler Glass Thermometer Corp.
- B. Source Limitations: Provide lead-free test plugs from single manufacturer.
- C. Description: Test-station fitting made for insertion into piping tee fitting.
- D. 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.
- E. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- G. Core Inserts: EPDM self-sealing rubber.

**PART 3 - EXECUTION****3.1 INSTALLATION**

- 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 direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

- H. Install valve and snubber in piping for each pressure gauge for fluids.
- I. Install test plugs in piping tees.
- J. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Each main hot-water-recirculating line return pipe.
  - 3. Else where as shown on the plans.
- K. Install pressure gauges in the following locations:
  - 1. Building water service entrance into building.
  - 2. Else where as shown on the plans.

### 3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

### 3.3 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.

### 3.4 THERMOMETER, LEAD FREE, SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping:
  - 1. 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping:
  - 1. 0 to 250 deg F.

### 3.5 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping:
  - 1. 0 to 100 psi.

END OF SECTION

**SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Brass ball valves.
  - 2. Steel ball valves.

**1.3 DEFINITIONS**

- A. CWP: Cold working pressure.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of valve.
  - 1. Certification that products comply with NSF 61 and NSF 372.

**1.5 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.

**PART 2 - PRODUCTS****2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- 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 solder-joint connections.
  - 4. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- 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 Types:
  - 1. Handlever: For quarter-turn valves smaller than NPS 4.
- G. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handles of nonthermal-conductive 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.

**2.2 BRASS BALL VALVES**

- A. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. Hammond Valve.
    - c. Jomar Valve.
    - d. KITZ Corporation.
    - e. Marwin Valve; Richards Industries.
    - f. Milwaukee Valve Company.

- g. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110 or MSS SP-145.
- b. CWP Rating: 600 psig.
- c. Body Design: Two piece.
- d. Body Material: Forged brass.
- e. Ends: Threaded and soldered.
- f. Seats: PTFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

2.3 STEEL BALL VALVES

A. Steel Ball Valves with Full Port, Class 150:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Flow Controls; Conbraco Industries, Inc.
  - b. FNW; Ferguson Enterprises, Inc.
  - c. Jamesbury; Metso.
  - d. NIBCO INC.
- 2. Description:
  - a. Standard: MSS SP-72.
  - b. CWP Rating: 285 psig.
  - c. Body Design: Split body.
  - d. Body Material: Carbon steel, ASTM A 216, Type WCB.
  - e. Ends: Flanged or threaded.
  - f. Seats: PTFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel, vented.
  - i. Port: Full.

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 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- 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.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
  - 1. Brass ball valves, two-piece with full port and stainless steel trim. Provide with threaded or solder-joint ends.

END OF SECTION



SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Thermal hanger-shield inserts.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.

## 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 carbon 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 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

**2.4 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

**2.5 MATERIALS**

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Grout: ASTM C 1107/C 1107M, 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. 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. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

- D. 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.
- E. Install lateral bracing with pipe hangers and supports to prevent swaying.
- F. 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.
- G. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- H. 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.
- I. 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.
  - 5. 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. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- B. 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

**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 copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. 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. 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.
  - 3. 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.
  - 4. 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.
  - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 7. Adjustable Band Hangers (MSS Type 9): 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.
- 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: 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.
- L. 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.
- M. 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.
- N. 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.
- 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 pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: 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 or 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, 1/16 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.

## 2.2 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.

## 2.3 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 or anodized aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
- 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.

### 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.

#### 3.4 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. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. At every change of direction greater than 45 degrees.
  4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  5. At access doors, manholes, and similar access points that permit view of concealed piping.
  6. Within 3 ft. of equipment items and other points of origination and termination.
  7. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
  8. On piping above removable acoustical ceilings. Install pipe labels at a 45-deg angle down from horizontal on both sides of piping to permit view from under and side of piping.
- 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. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
  2. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  3. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  4. Sanitary Waste Piping: White letters on a black background.

### 3.5 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, round.
    - b. Domestic Hot Water: 1-1/2 inches, round.
    - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
  2. Valve-Tag Colors:

# IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

LXT Eastside Development

## SECTION 220553

Project #47732472  
Permit Set 09/29/23

- 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.

END OF SECTION 220553

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**SECTION 220719 - PLUMBING PIPING INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Domestic recirculating hot-water piping.
  - 4. Supplies and drains for handicap-accessible lavatories and sinks.

**1.3 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).

**1.4 INFORMATIONAL SUBMITTALS**

- A. 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.

**1.5 QUALITY ASSURANCE**

- 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 and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "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.

## 1.8 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.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 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 shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall 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 shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.



- F. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Johns Manville; a Berkshire Hathaway company.
  - b. Knauf Insulation.
  - c. Manson Insulation Inc.
  - d. Owens Corning.
2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
3. 850 deg F.
4. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

## 2.4 MASTICS AND COATINGS

- A. Materials shall be 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. 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. 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 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 0 to plus 180 deg F.
3. Color: White.

## 2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be 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. 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.

## 2.6 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

## 2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. 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.

- 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. 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.

## 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

## 2.9 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
  - 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
- B. Wire: 0.062-inch soft-annealed, stainless steel.

## 2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. 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. 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, soften, or otherwise attack insulation or jacket in either wet or dry state.
- 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. 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.

- 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.
  - 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 more than 25 percent of its nominal thickness.
- 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.

### 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.
- 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 fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be 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 or sectional pipe 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 or sectional pipe 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, 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.

### 3.6 INSTALLATION OF MINERAL-FIBER 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 factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied 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 preformed 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 mineral-fiber 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 preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed 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 preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered 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.

### **3.7 FIELD-APPLIED JACKET INSTALLATION**

- A.** 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 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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.

**3.9 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.

**3.10 INDOOR PIPING INSULATION SCHEDULE**

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:

- a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
  - C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
    - 1. See Plumbing Fixture Schedule' on plans.
- 3.11 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. Piping, Concealed:
    - 1. None.
  - C. Piping, Exposed To View In Publicity Spaces :
    - 1. Aluminum
- END OF SECTION 220719

**SECTION 221116 - DOMESTIC WATER PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Piping joining materials.
  - 3. Encasement for piping.
  - 4. Transition fittings.
  - 5. Dielectric fittings

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Pipe and tube.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Transition fittings.

**1.4 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.

**PART 2 - PRODUCTS****2.1 PIPING MATERIALS**

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

**2.2 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. 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.
- G. Wrought Copper Unions: ASME B16.22.

**2.3 PIPING JOINING MATERIALS**

- A. Solder Filler Metals: ASTM B32, lead-free alloys.
- B. Flux: ASTM B813, water flushable.
- C. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing 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.

**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.

**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: 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.
- 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. 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.
  - D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
    1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
  - E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
    1. Drawn-temper copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
- 3.2 EARTHWORK
- A. Comply with requirements in Section 312000 "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 underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.
  - D. Install valves according to the following:
    1. Section 220523.12 "Ball Valves for Plumbing Piping."
  - E. Install domestic water piping level and plumb.
  - F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
  - G. 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.
  - H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
  - I. Install piping to permit valve servicing.

- J. 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.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 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. 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.
- G. 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.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

**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 or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

**3.7 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper, 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.
- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper to comply with MSS-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.



**3.9 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "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. 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. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. 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 interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Protect piping during construction period to avoid clogging with dirt and debris and to prevent damage from construction work.

C. 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. Submit water samples in sterile bottles to authorities having jurisdiction.
  - e. Repeat procedures if biological examination shows contamination.
- D. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

END OF SECTION 221116

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**SECTION 221316 - SANITARY WASTE AND VENT PIPING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless, cast-iron soil pipe and fittings.
  - 3. PVC pipe and fittings.
  - 4. Specialty pipe fittings.

**1.3 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.

**1.4 WARRANTY**

- A. Listed manufacturers to provide labeling and warranty of their respective products.

**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. Soil, Waste, and Vent Piping: 10-foot head of water.

**2.2 PIPING MATERIALS**

- A. Piping materials shall 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Caulking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and ASTM C 1540.
  - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

### 2.5 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

### 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Nonpressure Transition Couplings:

- a. Standard: ASTM C 1173.
  - 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 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.
3. 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.
4. 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. 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.
2. 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.

**PART 3 - EXECUTION****3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "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. 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 drain pipe.
    - 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.
- K. 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.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: 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. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. 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."
- N. Install steel piping according to applicable plumbing code.
- O. Install underground PVC piping according to ASTM D 2321.
- P. Install engineered soil and waste and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.



1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. 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.
- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### 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: Unshielded or 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 nipples.

### 3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "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.
- B. Install hangers for soil 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.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical runs of soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.6 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. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.
  - a. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. 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.

### 3.7 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.8 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 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 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-foot 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.

### 3.9 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. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil, waste, and vent piping shall be any of the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
  3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  3. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

**SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Show fabrication and installation details for frost-resistant vent terminals.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS****2.1 CLEANOUTS**

- A. Cast-Iron Exposed Cleanouts:
  - 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. Josam Company.
  - c. MIFAB, Inc.
  - d. Tyler Pipe; a subsidiary of McWane Inc.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
  3. Size: Same as connected drainage piping
  4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
  5. Closure: Countersunk, cast-iron plug.
  6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

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. Josam Company.
  - c. MIFAB, Inc.
  - d. Sioux Chief Manufacturing Company, Inc.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Closure: Brass plug with tapered threads.
6. Adjustable Housing Material: Cast iron with threads.
7. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
8. See Plumbing Fixture Schedule on plans for more details.

2.2 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

- a. NPS 2: 4-inch- minimum water seal.
- b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Inline Trap Seal:

- 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. Josam Company.
  - c. MIFAB, Inc.
  - d. Rectorseal Plumbing; A CSW Industrials Company.
- 2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
- 3. Material: Polymer.
- 4. Standard: Tested and certified in accordance with ASSE 1072.
- 5. Listing: ICC-ES or IAPMO listed.
- 6. Size: Same as floor drain outlet or strainer throat.

D. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

- 1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
- 2. Size: As required for close fit to riser or stack piping.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.



2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub 2 inches above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- G. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

### 3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

**SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Piping and related specialties for general-service compressed-air systems, as follows:
  - 1. Pipes, tubes, and fittings.
  - 2. Joining materials.
  - 3. Valves.
  - 4. Dielectric fittings.
  - 5. Flexible pipe connectors.
  - 6. Specialties.
  - 7. Quick couplings.

**1.2 DEFINITIONS**

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. HDPE: High-density polyethylene plastic.
- D. High-Pressure, Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.
- E. Low-Pressure, Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.
- F. NBR: Nitrile butadiene rubber.
- G. PE: Polyethylene plastic.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Dielectric fittings.
  - 2. Pressure regulators. Include rated capacities and operating characteristics.
  - 3. Quick couplings.

**PART 2 - PRODUCTS****2.1 SOURCE LIMITATIONS**

- A. Obtain each product type from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. ASME Compliance:

- 1. Comply with ASME B31.9, "Building Services Piping," for low-pressure, compressed-air piping.

**2.3 PIPES, TUBES, AND FITTINGS**

- A. Schedule 40, Steel Pipe: ASTM A53/A53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded in accordance with ASME B1.20.1.

- 1. Steel Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
  - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
  - 3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
  - 4. Steel Flanges, Threaded: ASME B16.5, Class 150 or 300, carbon steel, threaded.
  - 5. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

- B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

**2.4 JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

- 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

**2.5 VALVES**

- A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping."

**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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. A.Y. McDonald Mfg. Co.
    - b. Capitol Manufacturing Company.
    - c. GF Piping Systems: Georg Fischer LLC.
    - d. HART Industrial Unions, LLC.
    - e. Jomar Valve.
    - f. Matco-Norca.
    - g. Viega LLC.
    - h. WATTS; A Watts Water Technologies Company.
    - i. Wilkins.

- 2. Description:

- a. Standard: ASSE 1079.
    - b. Pressure Rating: 250 psig.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.

**2.7 FLEXIBLE PIPE CONNECTORS**

- A. Stainless Steel-Hose Flexible Pipe Connectors: Corrugated, stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.

- 1. Working-Pressure Rating: 200 psig minimum.
  - 2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.

**2.8 SPECIALTIES**

- A. Air-Line Pressure Regulators, Bronze Body: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200 psig minimum inlet pressure, unless otherwise indicated.

## 2.9 QUICK COUPLINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Aeroquip Performance Products; Eaton, Hydraulics Sector.
  - 2. Bowes Manufacturing Inc.
  - 3. Foster Manufacturing, Inc.
  - 4. Milton Industries, Inc.
  - 5. Parker (Parker Hannifin).
  - 6. Rectus Corp.
  - 7. Schrader-Bridgeport/Standard Thomson.
  - 8. TOMCO Products Inc.
  - 9. Tuthill Corporation.
- B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
- C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless steel or nickel-plated-steel operating parts.
  - 1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
  - 1. NPS 2 and Smaller, Threaded: Schedule 40, black -steel pipe; threaded, malleable-iron fittings; and threaded joints.

### 3.2 VALVE APPLICATIONS

- A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Article in Section 220523 "General-Duty Valves for Plumbing Piping," according to the following:
  - 1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
  - 2. High-Pressure Compressed Air: Valve types specified for high-pressure compressed air.

**3.3 INSTALLATION OF PIPING, GENERAL**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, 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 and to coordinate with other services occupying that space.
- E. Where installing piping adjacent to equipment and machines, allow space for service and maintenance.
- F. Install air and drain piping with 1 percent slope downward in direction of flow.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
  - 1. Use steel companion flange with gasket for connection to steel pipe.
- I. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, in accordance with Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F2014.
- J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- L. Install pressure gauge on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220500 "Common Work Results for Plumbing."
- M. Install piping to permit valve servicing.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.

**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 pipe and fittings before assembly.
- C. 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 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. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts in accordance with ASME B31.9 for bolting procedure.
- E. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

**3.5 INSTALLATION OF VALVES**

- A. General-Duty Valves: Comply with requirements in Section 220523 "General-Duty Valves for Plumbing Piping."

**3.6 INSTALLATION OF DIELECTRIC FITTINGS**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.

**3.7 INSTALLATION OF SPECIALTIES**

- A. Install air-line pressure regulators in branch piping to equipment and tools.
- B. Install quick couplings at piping terminals for hose connections.

**3.8 PIPING CONNECTIONS**

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

**3.9 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install hangers for 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.
- D. Support horizontal piping within 12 inches of each fitting and coupling.
- E. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Ft. or Less: MSS Type 1, adjustable, steel clevis hangers.
  - 2. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
- G. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- H. Base of Vertical Piping: MSS Type 52, spring hangers.

**3.10 LABELING AND IDENTIFICATION**

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

**3.11 FIELD QUALITY CONTROL**

- A. Perform field tests and inspections.
- B. Tests and Inspections:
  - 1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
  - 2. Repair leaks and retest until no leaks exist.
  - 3. Inspect pressure regulators for proper operation.



- C. Prepare test and inspection reports.

END OF SECTION

**SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:

- 1. Commercial, direct-vent, gas-fired, storage, domestic-water heater.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

**1.4 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

**PART 2 - PRODUCTS****2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS**

- A. Commercial, Direct-Vent, Gas-Fired, Storage, Domestic-Water Heaters:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Water Heaters.
    - b. Bradford White Corporation.
    - c. GSW Water Heating.
    - d. Lochinvar, LLC.
    - e. State Industries.
  - 2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  - 3. Standard: ANSI Z21.10.1/CSA 4.1.

4. Storage-Tank Construction: Steel.
  - a. Tappings: ASME B1.20.1 pipe thread.
  - b. Pressure Rating: 150 psig.
  - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed Storage-Tank Appurtenances:
  - a. Anode Rod: Replaceable magnesium.
  - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
  - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
  - d. Insulation: Comply with ASHRAE/IES 90.1.
  - e. Jacket: Steel with enameled finish.
  - f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
  - g. Burner: For use with direct-vent, gas-fired, domestic-water heaters and natural-gas fuel.
  - h. Ignition: Standing pilot or ANSI Z21.20/CSA C22.2 No. 60730-2-5, electric, automatic, gas-ignition system.
  - i. Temperature Control: Adjustable thermostat.
  - j. Combination Temperature-and-Pressure Relief Valve: ANSI Z21.22/CSA 4.4. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valve with sensing element that extends into storage tank.
6. Direct-Vent System: Through-wall, coaxial- or double-channel vent assembly with domestic-water heater manufacturers' outside intake/exhaust screen.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  2. Maintain manufacturer's recommended clearances.
  3. Arrange units so controls and devices that require servicing are accessible.
  4. 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.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.
  - B. Install 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 220523.12 "Ball Valves for Plumbing Piping."
  - C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
    1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
    2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
    3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
    4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."
  - D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
  - E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
  - F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
  - G. Fill domestic-water heaters with water.
  - H. Charge domestic-water expansion tanks with air to required system pressure.
  - I. 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 domestic-water piping specified in Section 221116 "Domestic Water Piping."

- B. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, 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 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION

**SECTION 224213.13 - COMMERCIAL WATER CLOSETS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Water closets.
  - 2. Flushometer valves and tanks.
  - 3. Toilet seats.
  - 4. Supports.

**1.3 DEFINITIONS**

- A. Effective Flush Volume: Average of two reduced flushes and one full flush per fixture.
- B. Remote Water Closet: Located more than 30 feet from other drain line connections or fixture and where less than 1.5 drainage fixture units are upstream of the drain line connection.

**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 water closets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

**PART 2 - PRODUCTS****2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS****A. Water Closets: Floor mounted, back outlet, top spud.**

1. See Plumbing Fixture Schedule on plans for more details.

**B. Water Closets: Wall mounted.**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard America.
  - b. Crane Plumbing, L.L.C.
  - c. Kohler Co.
  - d. TOTO USA, INC.
  - e. Zurn Industries, LLC.
2. Bowl:
  - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - b. Material: Vitreous china.
  - c. Type: Siphon jet.
  - d. Style: Flushometer valve.
3. See Plumbing Fixture Schedule on plans for more details.

**2.2 FLUSHOMETER VALVES****A. Diaphragm Flushometer Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Sloan Valve Company.
  - b. Zurn Industries, LLC.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. See Plumbing Fixture Schedule on plans for more details.

**2.3 TOILET SEATS****A. Toilet Seats:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard America.
  - b. Bemis Manufacturing Company.
  - c. Church Seats; Bemis Manufacturing Company.
  - d. Kohler Co.
  - e. Olsonite Seat Co.
  - f. TOTO USA, INC.
  - g. Zurn Industries, LLC.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Hinge Material: Noncorroding metal.
5. See Plumbing Fixture Schedule on plans for more details.

**2.4 SUPPORTS****A. Water Closet Carrier:**

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Zurn Industries, LLC.
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 where distance from face of wall to face of carrier exceed 7".

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 INSTALLATION

#### A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

#### B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
4. Provide additional support legs on carriers that exceed seven inches in length from face of carrier to face of restroom wall.

#### C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

#### D. Install toilet seats on water closets.

#### E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.

#### F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

#### A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

#### 3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

#### 3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

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**SECTION 224213.16 - COMMERCIAL URINALS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Wall-hung urinals.
  - 2. Urinal flushometer valves.
  - 3. Supports.

**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 urinals.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

**PART 2 - PRODUCTS****2.1 WALL-HUNG URINALS**

- A. Urinals - Wall Hung, Back Outlet, Washout:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Standard.
- b. Kohler Co.
- c. TOTO USA, INC.
- d. Zurn Industries, LLC.

2. Fixture:

- a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5/CSA B45.15.
- b. Material: Vitreous china.
- c. Type: Washout with extended shields.

## 2.2 URINAL FLUSHOMETER VALVES

A. Hard-Wired, Solenoid-Actuator, Piston Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Sloan Valve Company.
  - b. TOTO USA, INC.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. See Plumbing Fixture Schedule on plans for more details.

## 2.3 SUPPORTS

A. Type I Urinal Carrier:

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. Josam Company.
  - c. MIFAB, Inc.
  - d. Wade Drains.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION****A. Urinal Installation:**

- 1. Install urinals level and plumb according to rough-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 for the handicapped/elderly, according to ICC A117.1.
- 5. Install trap-seal liquid in waterless urinals.

**B. Support Installation:**

- 1. Install supports, affixed to building substrate, for wall-hung urinals.
- 2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
- 3. Use carriers without waste fitting for urinals with tubular waste piping.
- 4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

**C. Flushometer-Valve Installation:**

- 1. Install flushometer-valve water-supply fitting on each supply to each urinal.
- 2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
- 3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

**D. Wall Flange and Escutcheon Installation:**

- 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
- 2. Install deep-pattern escutcheons if required to conceal protruding fittings.

**E. Joint Sealing:**

- 1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.

2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 PIPING CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

### 3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION

**SECTION 224216.13 - COMMERCIAL LAVATORIES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Enameled, cast-iron, counter-mounted lavatories.
2. Vitreous-china, counter-mounted lavatories.
3. Enameled, cast-iron, wall-mounted lavatories.
4. Vitreous-china, wall-mounted lavatories.
5. Automatically operated lavatory faucets.
6. Supply fittings.
7. Waste fittings.
8. Lavatory supports.

**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 lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

**B. Shop Drawings:** Include diagrams for power, signal, and control wiring of automatic faucets.**1.3 CLOSEOUT SUBMITTALS****A. Operation and Maintenance Data:** For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - a. Servicing and adjustments of automatic faucets.

**PART 2 - PRODUCTS****2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES****A. Lavatory - Vitreous China, Undercounter Mounted:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
  - c. TOTO USA, INC.
  - d. Zurn Industries, LLC.
2. Fixture:
  - a. Standard: ASME A112.19.2/CSA B45.1.
  - b. Type: For undercounter mounting.
  - c. Faucet-Hole Location: On countertop.
  - d. Mounting Material: Sealant and undercounter mounting kit.
3. See Plumbing Fixture Schedule on plans for more details.

## 2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

### A. Lavatory - Ledge Back, Vitreous China, Wall Mounted:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Kohler Co.
2. Fixture:
  - a. Standard: ASME A112.19.2/CSA B45.1.
  - b. Type: For wall hanging.
  - c. Faucet-Hole Location: Top.
  - d. Mounting Material: Chair carrier.
3. See Plumbing Fixture Schedule on plans for more details.

## 2.3 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory 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/NSF 372, or be certified in compliance with NSF 61/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.
- B. Lavatory Faucets - Manual Type: , Commercial,:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard.
  - b. Chicago Faucets; Geberit Company.
  - c. Delta Faucet Company.
  - d. Elkay Manufacturing Co.
  - e. GROHE America, Inc.
  - f. Just Manufacturing.
  - g. Kohler Co.
  - h. Moen Incorporated.
  - i. Speakman Company.
  - j. T&S Brass and Bronze Works, Inc.
  - k. Zurn Industries, LLC.
2. Standard: ASME A112.18.1/CSA B125.1.
3. See Plumbing Fixture Schedule on plans for more details.

#### 2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. 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.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
  1. NPS 1/2.
  2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

#### 2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material:
  - a. 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.

## 2.6 LAVATORY SUPPORTS

### A. Lavatory Carrier:

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. Josam Company.
  - c. MIFAB, Inc.
  - d. Wade; a subsidiary of McWane Inc.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. 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 220518 "Escutcheons for Plumbing Piping."

- E. 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 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 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 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

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**SECTION 224216.16 - COMMERCIAL SINKS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Service sinks.
  - 2. Kitchen/utility sinks.
  - 3. Manually operated sink faucets.
  - 4. Supply fittings.
  - 5. Waste fittings.

**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 sinks.
  - 2. Include rated capacities, operating characteristics and furnished specialties and accessories.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

**PART 2 - PRODUCTS****2.1 SERVICE SINKS****A. Service Sinks - Molded Stone, Floor Mounted:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fiat Products.
  - b. Florestone Products Co., Inc.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
  - a. Standard: ASME A112.18.2/CSA B125.2.
4. Mounting: On floor and flush to wall.
5. See Plumbing Fixture Schedule on plans for more details.

**2.2 KITCHEN/UTILITY SINKS****A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Tabco.
  - b. Eagle Group.
  - c. Elkay Manufacturing Co.
  - d. Franke.
  - e. Just Manufacturing.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
  - a. Standard: ASME A112.19.3/CSA B45.4.
  - b. Type: Stainless steel, self-rimming, sound-deadened unit less ledge back.
4. See Plumbing Fixture Schedule on plans for more details.

**B. Kitchen/Utility Sinks - Stainless Steel, Freestanding:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Tabco.
  - b. AERO Manufacturing Company.
  - c. Amtekco Industries, Inc; a Wasserstrom Company.
  - d. Eagle Group.
  - e. Elkay Manufacturing Co.
  - f. Franke.
  - g. Griffin Products, Inc.
  - h. Just Manufacturing.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
  - a. Standards:
    - 1) ASME A112.19.3/CSA B45.4.
    - 2) NSF 2.
  - b. Type: Stainless steel, freestanding, sound-deadened unit with backsplash.
4. See Plumbing Fixture Schedule on plans for more details.

## 2.3 MANUALLY OPERATED SINK FAUCETS

- A. Sink 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. Commercial Sink Faucets - Manual Type: Single-control mixing .
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard.
    - b. Chicago Faucets; Geberit Company.
    - c. Elkay Manufacturing Co.
    - d. Just Manufacturing.
    - e. Kohler Co.
    - f. Speakman Company.
    - g. T&S Brass and Bronze Works, Inc.
    - h. Zurn Industries, LLC.
  2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
  3. Standard: ASME A112.18.1/CSA B125.1.
  4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
  5. See Plumbing Fixture Schedule on plans for more details.

C. Commercial Service Sink Faucets - Manual Type:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. American Standard.
  - c. Chicago Faucets; Geberit Company.
  - d. Fiat Products.
  - e. Kohler Co.
  - f. Speakman Company.
  - g. Stern-Williams Co., Inc.
  - h. T&S Brass and Bronze Works, Inc.
  - i. Zurn Industries, LLC.
2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. 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.
4. Faucet:
  - a. Standards:
    - 1) ASME A112.18.1/CSA B125.1.
    - 2) NSF 61 and NSF 372.
    - 3) ICC A117.1.
    - 4) ASSE 1001 (VB).
5. See Plumbing Fixture Schedule on plans for more details.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. 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.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:
  1. NPS 1/2.

2. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

## 2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
  1. Size: NPS 1-1/2.
  2. 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. Refer to Section 226600 for acid waste applications.

## 2.6 SINK SUPPORTS

- A. Sink Carrier:
  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. Josam Company.
    - c. MIFAB, Inc.
    - d. Wade Drains.
    - e. WATTS.
    - f. Zurn Industries, LLC.
  2. Source Limitations: Obtain sink supports from single source from single manufacturer.
  3. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".
  - 2. Install stops in locations where they can be easily reached for operation.
- C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- D. Seal joints between sinks and 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 079200 "Joint Sealants."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 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 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

**SECTION 224716 - PRESSURE WATER COOLERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pressure water coolers.
  - 2. Supports.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of pressure water cooler and bottle filling station.
  - 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.
- B. Shop Drawings:
  - 1. Include diagrams for power wiring.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For pressure water coolers and bottle filling stations to include in maintenance manuals.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Standards:

1. Pressure water coolers 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 ASHRAE 34 for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
3. Comply with UL 399.
4. Comply with ASME A112.19.3/CSA B45.4.
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. Comply with NSF 42 and NSF 53 for water filters for water coolers and bottle filling stations.
7. Comply with ICC A117.1 for accessible water coolers and bottle filling stations.

## 2.2 PRESSURE WATER COOLERS

### A. Pressure Water Coolers - Surface Wall-Mounted, Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Elkay.
  - b. Halsey Taylor.
  - c. Murdock Manufacturing; A Division of Morris Group International.
  - d. Oasis International.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, pressure water coolers from single source from single manufacturer.
3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
4. See Plumbing Fixture Schedule on plans for more details.

## 2.3 SUPPORTS

### A. Water-Cooler Carrier:

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. Josam Company.
  - c. MIFAB, Inc.
  - d. Wade Drains.
  - e. Zurn Industries, LLC.
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. Set freestanding, pressure water coolers on floor.
- C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers, and bottle filling stations to mounting frames.
- E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings.
- H. 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 079200 "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 221116 "Domestic Water Piping."

- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

### 3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

### 3.6 CLEANING

- A. After installing fixture, 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

# **BASIC MECHANICAL REQUIREMENTS FOR HVAC**

LXT Eastside Development

## **SECTION 230010**

Project #47732472  
Permit Set 09/29/23

### **SECTION 230010 - BASIC MECHANICAL REQUIREMENTS FOR HVAC**

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

1.1 Refer to requirements listed in section 220010.

#### **PART 2 - PRODUCTS (Not Applicable)**

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

3.1 Refer to requirements listed in section 220010.

END OF SECTION 230010

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# **BASIC MECHANICAL REQUIREMENTS FOR HVAC**

LXT Eastside Development

## **SECTION 230010**

Project #47732472  
Permit Set 09/29/23

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**SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

**A. Section Includes:**

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Pipe stands.
4. Equipment supports.

**B. Related Requirements:**

- 1.
2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**1.4 QUALITY ASSURANCE**

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports for HVAC 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.

## 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 carbon steel or stainless steel.

## 2.3 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.

## 2.4 PIPE STANDS

### A. C-Series rubber support blocks with strut by C-Port or equal.

## 2.5 EQUIPMENT SUPPORTS

### A. Description: 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; 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.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. 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 the building structure.
- B. 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.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. 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.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.

- G. 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.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. 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.

### 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 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.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. 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 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 and attachments for general service applications.
- F. 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.
- G. 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.
- H. 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.
- I. 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.
- J. 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.
- K. 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.
- L. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION



**SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Spring hangers.
  - 3. Snubbers.

**1.3 DEFINITIONS**

- A. IBC: International Building Code.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Include load rating for each wind-force-restraint fitting and assembly.
  - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device component.
  - 4. Annotate to indicate application of each product submitted and compliance with requirements.
  - 5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
  - 1. Detail fabrication and assembly of equipment bases.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Fire/Smoke Resistance: All components that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- B. Component Supports:
  - 1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.

**2.2 ELASTOMERIC ISOLATION PADS**

- A. Elastomeric Isolation Pads:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ace Mountings Co., Inc.
    - b. CADDY; a brand of nVent.
    - c. California Dynamics Corporation.
    - d. Isolation Technology, Inc.
    - e. Kinetics Noise Control, Inc.
    - f. Korfund.
    - g. Mason Industries, Inc.
    - h. Novia; A Division of C&P.
    - i. Vibration Eliminator Co., Inc.
    - j. Vibration Management Corp.
    - k. Vibration Mountings & Controls, Inc.
  - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 3. Size: Factory or field cut to match requirements of supported equipment.
  - 4. Minimum deflection as indicated on Drawings.
  - 5. Pad Material: Oil- and water-resistant rubber.
  - 6. Sandwich-Core Material: Resilient and elastomeric.

**2.3 SPRING HANGERS**

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ace Mountings Co., Inc.
  - b. CADDY; a brand of nVent.
  - c. California Dynamics Corporation.
  - d. Kinetics Noise Control, Inc.
  - e. Mason Industries, Inc.
  - f. Novia; A Division of C&P.
  - g. Vibration Eliminator Co., Inc.
  - h. Vibration Isolation.
  - i. Vibration Management Corp.
  - j. Vibration Mountings & Controls, Inc.
2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Minimum deflection as indicated on Drawings.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

## 2.4 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. CADDY; a brand of nVent.
  2. Kinetics Noise Control, Inc.
  3. Mason Industries, Inc.
  4. Vibration Management Corp.
  5. Vibration Mountings & Controls, Inc.
- B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
3. Anchors in Masonry: Design in accordance with TMS 402.
4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLICATIONS

- A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength is adequate to carry static and wind force loads within specified loading limits.

#### 3.3 INSTALLATION OF VIBRATION CONTROL DEVICES

- A. Provide vibration control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Device Schedules on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- C. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- D. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- E. Equipment Restraints:

1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

### 3.4 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548.13

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Stencils.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

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. Label Content: Include equipment's Drawing designation or unique equipment number.

**2.2 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.

**2.3 DUCT LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 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 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.

## 2.4 STENCILS

### A. 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, acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: Color as indicated for specific application under Part 3.

### B. 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, acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. 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.

**3.4 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. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. At every change of direction greater than 45-degrees.
  - 4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 5. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 6. Within 3 ft. of equipment items and other points of origination and termination.
  - 7. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.
  - 8. On piping above removable acoustical ceilings. Install pipe labels at a 45-deg angle down from horizontal on both sides of piping to permit view from under and side of piping.
- 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 Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:
  - 1. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.

**3.5 INSTALLATION OF DUCT LABELS**

- A. Install plastic-laminated or self-adhesive 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.
- 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 50 ft. where concealed by removable ceiling system.
- D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  - 1. Black letters on White background.

END OF SECTION 230553

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**SECTION 230713 - DUCT INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 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, return air.
  - 4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
- B. Related Sections:
  - 1. Section 233113 "Metal Ducts" for duct liners.

**1.3 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.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

**1.5 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "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.

**1.6 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.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

**PART 2 - PRODUCTS****2.1 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 shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, 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. CertainTeed Corporation.
  - b. Johns Manville; a Berkshire Hathaway company.
  - c. Knauf Insulation.
  - d. Manson Insulation Inc.
  - e. Owens Corning.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation 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. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.3 MASTICS AND COATINGS

- A. Materials shall be 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 C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Color: White.
- C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM C 755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 2. Service Temperature Range: 0 to 180 deg F.
  - 3. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM E 96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White.

## 2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

## 2.5 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

## 2.7 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

## 2.8 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.

3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

## 2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal closed seal.
3. 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, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
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. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. 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. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive-backed base with a peel-off protective cover.
  5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum, or stainless-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. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  6. 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.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.

## 2.10 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 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, soften, or otherwise attack insulation or jacket in either wet or dry state.
- 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.
- 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.

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 more than 75 percent of its nominal thickness.
- 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 Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket 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, 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 shall 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.
- B. 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 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 shall 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.

### 3.6 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: 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 shall be 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.

### 3.8 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, return air.
  - 4. Indoor, concealed exhaust between isolation damper and penetration of building exterior and all exhaust ductwork downstream of energy recovery ventilator.
- 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.

**3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

- A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
- B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
  - 1. Lined: Refer to 23 31 13.
- C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
- D. Concealed, rectangular, supply-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
  - 2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density minimum R-5.0.
- E. Concealed, rectangular, return-air duct insulation shall be one of the following:
  - 1. Lined: Refer to 23 31 13.
- F. Concealed, rectangular, outdoor-air duct insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density minimum R-5.0 installed.
  - 2. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density minimum R-5.0.
- G. Concealed, round/rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior and all exhaust ductwork downstream of energy recovery ventilator shall be one of the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 3-lb/cu. ft. nominal density minimum R-5.0 installed.
  - 2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density minimum R-5.0.

END OF SECTION

**SECTION 231123 - 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. Pressure regulators.
6. 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. 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 pressure regulator assembly.

#### 1.4 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.

#### 1.5 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.

#### 1.6 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 083113 "Access Doors and Frames."
- C. Coordinate requirements for piping identification for natural-gas piping. Comply with requirements in Section 220553 "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 the International Fuel Gas Code.
- B. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- C. Natural-Gas System Pressure within Buildings:
  - 1. 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.
- 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.

**2.3 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.

## 2.4 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
3. Corrugated, stainless steel tubing with polymer coating.
4. Operating-Pressure Rating: 0.5 psig.
5. End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72 inches.

### B. 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.

## 2.5 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

## 2.6 MANUAL GAS SHUTOFF VALVES

- A. See "Underground, Manual Gas Shutoff Valve Schedule" and "Aboveground, Manual Gas Shutoff Valve Schedule" articles for where each valve type is applied in various services.

### B. General Requirements for Metallic Valves, NPS 2 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.

- C. General Requirements for Metallic Valves, NPS 2-1/2 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.
- 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.
    - d. Lyall, R. W. & Company, Inc.
    - e. Perfection Corporation.
  - 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.

## 2.7 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. Line Pressure Regulators: Comply with ANSI Z21.80A.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Actaris.
    - b. American Meter Company.
    - c. Dormont; a WATTS brand.
    - d. Eclipse Innovative Thermal Technologies.
    - e. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
    - f. Invensys.
    - g. Itron Gas.
    - h. Maxitrol Company.
    - i. Richards Industries.
  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: 5 psig.
- C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a.
    - b. Dormont; a WATTS brand.
    - c. Eaton.
    - d. Harper Wyman Co.
    - e. Maxitrol Company.
    - f. SCP, Inc.
  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: 2 psig.

**2.8 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. Capitol Manufacturing Company.
- c. Central Plastics Company.
- d. HART Industrial Unions, LLC.
- e. Jomar Valve.
- f. Matco-Norca.
- g. WATTS.
- h. Wilkins.
- i. 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, provide products by one of the following:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. Matco-Norca.
- d. WATTS.
- e. 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, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
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.

### 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 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for preventing accidental ignition.

#### 3.3 INSTALLATION OF OUTDOOR PIPING

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. 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.

- C. Install fittings for changes in direction and branch connections.

### 3.4 INSTALLATION OF INDOOR PIPING

- A. Comply with 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 capped.

- 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 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.
  - 3. 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 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.



**3.5 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.

**3.6 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- E. 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.

**3.7 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

- B. Install hangers for 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.
- C. 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.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of steel piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. 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.

### 3.8 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.

### 3.9 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

### 3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas in accordance with 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.

**3.11 OUTDOOR PIPING SCHEDULE**

- A. 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.

**3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG**

- A. Aboveground, branch piping NPS 1 and smaller is to be one of the following:
  - 1. 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.

**3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG**

- A. Aboveground, branch piping NPS 1 and smaller is to be the following:
  - 1. 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.

**3.14 ABOVEGROUND, MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Valves for pipe sizes NPS 2-1/2 and larger at service meter are to be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller are to be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger are to be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
- D. Valves in branch piping for single appliance are to be the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

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**SECTION 233113 - METAL DUCTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY****A. Section Includes:**

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Double-wall round ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

**B. Related Sections:**

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

**1.3 ACTION SUBMITTALS****A. Product Data:** For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

**B. Sustainable Design Submittals:**

1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."

**C. 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 and vibration isolation.

#### 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.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" . .
- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

- E. 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 316 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 shall 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 shall 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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ductmate Industries, Inc.
    - b. Elgen Manufacturing.
    - c. Linx Industries (formerly Lindab).
    - d. McGill AirFlow LLC.
    - e. MKT Metal Manufacturing.
    - f. Nordfab Ducting.
    - g. SEMCO LLC.
    - h. Set Duct Manufacturing.
    - i. Sheet Metal Connectors, Inc.
    - j. Spiral Manufacturing Co., Inc.
    - k. Spiral Pipe of Texas.
    - l. Stamped Fittings Inc.
    - m. Wichita Sheet Metal Supply, Inc.
  - B. 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.
  - C. 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.
  - D. 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."
- 2.4 DOUBLE-WALL ROUND[ AND FLAT-OVAL] DUCTS AND FITTINGS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Linx Industries (formerly Lindab).
    2. McGill AirFlow LLC.
    3. MKT Metal Manufacturing.



4. SEMCO LLC.
  5. Set Duct Manufacturing.
  6. Sheet Metal Connectors, Inc.
  7. Spiral Pipe of Texas.
  8. Wichita Sheet Metal Supply. Inc.
- B. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, 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.

## 2.5 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 shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, 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.
- G. 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.

**2.6 DUCT LINER**

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, 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 Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
  - 2. 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.
  - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Insulation Pins and Washers:
  - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-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.
- C. 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. 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.

7. 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.
8. 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.

## 2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall 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: 4 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. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.
  - 4. Class: 25.
  - 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall 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.

## 2.8 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 A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- 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 233300 "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.
- 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 DUCT SEALING

- A. Seal all ducts to minimum SMACNA Seal Class A.

### 3.4 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.
- 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.

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 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 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

### 3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.9 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.
- B. Supply Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 1- inch wg.
    - b. SMACNA Leakage Class for Rectangular: 4.
    - c. SMACNA Leakage Class for Round and Flat Oval: 2.
  - 2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 2- inch wg.
    - b. SMACNA Leakage Class for Rectangular: 4.
    - c. 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 1- inch wg.
    - b. SMACNA Leakage Class for Rectangular: 4.
    - c. 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. SMACNA Leakage Class for Rectangular: 4.
    - c. SMACNA Leakage Class for Round and Flat Oval: 2.
  - 2. Ducts Connected to Equipment Not Listed above:
    - a. Pressure Class: Positive or negative 2- inch wg.
    - b. SMACNA Leakage Class for Rectangular: 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. SMACNA Leakage Class for Rectangular: 8.
  - 2. SMACNA Leakage Class for Round and Flat Oval: 8.
- F. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- G. Liner:
  - 1. Supply-Air Ducts: Fibrous glass, Type I, 1 inch(es) thick.
    - a. Exposed rectangular ductwork.



- b. Exposed round ductwork.
    - c. First 15 feet of ductwork downstream of equipment outlets.
  - 2. Return-Air Ducts: Fibrous glass, Type I, 1 inch(es) thick.
  - 3. Transfer Ducts: Fibrous glass, Type I, 1 inch(es) thick.
- H. Double-Wall Duct Interstitial Insulation:
  - 1. Supply-Air Ducts: 1 inch(es) thick.
  - 2. Return-Air Ducts: 1 inch(es) thick.
- I. Elbow Configuration:
  - 1. Rectangular Duct: 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. 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 233113

**SECTION 233300 - AIR DUCT ACCESSORIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY****A. Section Includes:**

1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Turning vanes.
5. Duct-mounted access doors.
6. Duct access panel assemblies.
7. Flexible connectors.
8. Duct accessory hardware.

**B. Related Requirements:**

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.

**1.3 ACTION SUBMITTALS****A. Product Data:** For each type of product.**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.

**1.4 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.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in 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. 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 MANUAL VOLUME DAMPERS**

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance; a division of MESTEK, Inc.
    - b. Aire Technologies.
    - c. American Warming and Ventilating; a Mestek Architectural Group company.
    - d. Arrow United Industries.
    - e. Cesco Products; a division of MESTEK, Inc.
    - f. Greenheck Fan Corporation.
    - g. Lloyd Industries, Inc.

- h. McGill AirFlow LLC.
    - i. Nailor Industries Inc.
    - j. Pottorff.
    - k. Ruskin Company.
    - l. Safe Air - Dowco Products.
    - m. United Enertech.
    - n. Vent Products Co., 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: Stainless steel.
  - 7. Bearings:
    - a. Stainless steel sleeve.
    - 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. Jackshaft:
- 1. Size: 1-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.

C. 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.

## 2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Arrow United Industries.
3. Carnes Company.
4. Cesco Products; a division of MESTEK, Inc.
5. Greenheck Fan Corporation.
6. Lloyd Industries, Inc.
7. McGill AirFlow LLC.
8. Metal Form Manufacturing, Inc.
9. Nailor Industries Inc.
10. NCA Manufacturing, Inc.
11. Pottorff.
12. Ruskin Company.
13. Safe Air - Dowco Products.
14. United Enertech.
15. Vent Products Co., Inc.
16. Young Regulator Company.

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.
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 2000 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. Opposed-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 stainless steel sleeve.
  - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. Electric - 120 V ac.
2. UL 873, plenum rated.
3. Two position, , or modulatingwith fail-safe spring return as indicated on controls drawings.
  - 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.

## 2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Aire Technologies.
  - 2. Arrow United Industries.
  - 3. Greenheck Fan Corporation.
  - 4. NCA Manufacturing, Inc.
  - 5. Pottorff.
  - 6. Prefco.
  - 7. Ruskin Company.
  - 8. Safe Air - Dowco Products.
  - 9. United Enertech.
  - 10. Vent Products Co., Inc.
- B. Type: Static; 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 hours.
- E. Frame: Curtain type with blades outside 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, interlocking. Material gauge is to be in accordance with UL listing.
- I. Heat-Responsive Device:
  - 1. Replaceable, 165 deg F rated, fusible links.

## 2.5 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



1. Aero-Dyne Sound Control Co.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.

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.

C. 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."

D. Vane Construction:

1. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.6 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.
4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Cable: Steel.

## 2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow LLC.
5. Ruskin Company.
6. United Enertech.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2, "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 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.

## 2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.
  4. Ventfabrics, Inc.
  5. Ward Industries; a brand of Hart & Cooley, Inc.
- 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.

## 2.9 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc.
  - 3. Duro Dyne Inc.
  - 4. DynAir; a Carlisle Company.
  - 5. Elgen Manufacturing.
  - 6. Hardcast; a Carlisle Company.
  - 7. United Enertech.
  - 8. Ventfabrics, Inc.
  - 9. Ward Industries; a brand of Hart & Cooley, Inc.
- 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.

## 2.10 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.
- 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 control 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 dampers in accordance with UL listing.
- I. 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 and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.
  5. 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.
  6. At each change in direction and at maximum 50-ft. spacing.
  7. Upstream and downstream from turning vanes.
  8. Control devices requiring inspection.
  9. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. 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.
- L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Install duct test holes where required for testing and balancing purposes.
- P. 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 233300

**SECTION 233346 - FLEXIBLE DUCTS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Insulated flexible ducts.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

**PART 2 - PRODUCTS****2.1 INSULATED FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. JP Lamborn Co..
  - 3. McGill AirFlow LLC.
  - 4. Thermaflex; a Flex-Tek Group company.
  - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-Value: R6.

## 2.2 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
- B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not 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 flexible ducts to metal ducts with liquid adhesive plus tape.
- E. Install duct test holes where required for testing and balancing purposes.
- F. Installation:
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall 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.
- G. Supporting Flexible Ducts:
  - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  - 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 shall not exceed the maximum spacing per manufacturer's written installation instructions.
  - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION





**SECTION 233416 - CENTRIFUGAL HVAC FANS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Square in-line centrifugal fans.

**1.2 ACTION SUBMITTALS****A. Product Data:** For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Fan speed controllers.

**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. Belts: One set(s) for each belt-driven unit.

**PART 2 - PRODUCTS****2.1 SQUARE IN-LINE CENTRIFUGAL FANS****A. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry; division of Air System Components.

- B. Description: Square in-line centrifugal fans.
- C. Housing:
  - 1. Housing Material: Reinforced steel.
  - 2. Housing Coating: See schedule.
  - 3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosures around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.
- G. Motor Enclosure: Open, dripproof.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting:
  - 1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
  - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install units with clearances for service and maintenance.
- F. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

### 3.2 DUCTWORK AND PIPING CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. 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.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "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 260553 "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.

### 3.5 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.

### 3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.
- D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  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. Replace damaged and malfunctioning controls and equipment.
  3. Fans and components will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

**SECTION 233439 - HIGH-VOLUME, LOW-SPEED FANS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes high-volume, low-speed fans.

**1.3 DEFINITIONS**

- A. HVLS - High volume, low speed.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, furnished specialties, and accessories for each fan.
  - 2. Certified fan performance curves with system operating conditions indicated.
  - 3. Certified fan sound-power ratings.
  - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 5. Material thickness and finishes, including color charts.
  - 6. Fan speed controllers.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
  - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.

2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

## 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: Listed and labeled to UL 507.
- C. CSA Compliance: Listed and labeled to CSA C22.2, No. 113.
- D. Comply with NFPA 13 requirements for HVLS fans.
- E. AMCA Compliance:
  1. Test HVLS fans according to AMCA 230.
  2. Certify HVLS fan performance according to AMCA 211.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Big Ass Fans.
  2. MacroAir.
  3. Greenheck.
- B. Source Limitations: Obtain HVLS fans from single source from single manufacturer.

### 2.3 HIGH-VOLUME, LOW-SPEED FANS

- A. Description: Factory-assembled and -tested horizontal, non-ducted fan unit, consisting of large-diameter blade set, direct-drive electric motor, with speed-reducing gearbox variable-speed motor controller.
  1. Provide fan designed to circulate large air volume, vertically, at low velocity.
  2. Maximum Operating Temperature: 122 deg F.
  3. Frame:
    - a. Material: Galvanized steel.

- 1) Finish: Paint .
4. Blades: Airfoil type.
  - a. Material: Aluminum.
    - 1) Blade Finish: Anodized.
5. Motor: , integral to fan frame .
6. Controls: Provide wall-mounted keypad.
  - a. Provide automatic variable speed motor controller speed control.
7. Standard Mounting Bracket: Steel beam/steel angle.
8. Accessories:
  - a. Mounting extension tube.
  - b. .

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting HVLS fan performance, maintenance, and operations.
  1. Fan locations indicated on Drawings are approximate. Determine exact locations before roughing-in for mounting, control, and electrical connections.
- B. Examine roughing-in for mounting location, anchor-bolt sizes, and locations, to verify actual locations for mounting connections before installation of fan.
- C. Examine areas for suitable conditions where fan will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS

- A. Install fan according to manufacturer's published instructions.
- B. Comply with NECA 1 and NFPA 70.
- C. Comply with NFPA 13 for installation of HVLS fans and maximum allowable fan diameter. Center HVLS fans between four adjacent sprinklers. Minimum vertical clearance from HVLS fan to sprinkler deflector is 3 feet.



- D. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire alarm system.
- E. Equipment Mounting:
  - 1. Anchor fan to building structure with manufacturer's recommended mounting bracket for installed condition.
  - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
  - 3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- F. Install unit to permit access for maintenance.
- G. Install parts and accessories shipped loose.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "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 260553 "Identification for Electrical Systems."
- E. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but not factory mounted.

### 3.4 CONTROL CONNECTIONS

- A. Connect control wiring to field-mounted control devices.
- B. Connect control interlock wiring between HVLS fan and other equipment to provide a complete and functioning system.
- C. Install control devices furnished by manufacturer, but not factory mounted.
- D. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not factory mounted.

- E. Protect installed units from damage caused by other work.

### 3.5 CLEANING

- A. Clean equipment externally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following manufacturer's cleaning procedures, and clean with manufacturer-recommended cleaning products.

END OF SECTION 233439

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**SECTION 233700 - AIR INLETS AND OUTLETS****PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Grilles And Registers.
- B. Louvers.
- C. Roof Hoods.

**1.2 QUALITY ASSURANCE**

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.

**1.3 REFERENCES**

- A. AMCA 500-L-12 - Laboratory Methods of Testing Louvers for Rating.
- B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. SMACNA - Duct Construction Standards.

**1.4 SUBMITTALS**

- A. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- B. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.
- C. Submit manufacturer's installation instructions.
- D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

**1.5 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

**PART 2 - PRODUCTS****2.1 AIR TERMINALS - GRILLES, REGISTERS, AND DIFFUSERS**

- A. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- B. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- C. The capacity and size of the unit shall be as shown on the drawings.
- D. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10<sup>-12</sup> watts with a 10 dB room effect. .
- E. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
- F. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- G. Manufacturers:
  - 1. Tuttle & Bailey
  - 2. Titus
  - 3. Price
  - 4. Nailor
  - 5. Carnes
  - 6. Metalaire
  - 7. Krueger

**2.2 LOUVERS - FIXED - ALUMINUM**

- A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.

- B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.
- C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.
- D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.
- E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.
- F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.
- G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.
- H. Louvers shall be suitable for duct connection.
- I. Manufacturers:
  - 1. Ruskin - "ELF375DX"
  - 2. Greenheck - ESD "403"
  - 3. Pottorff - EFD

## 2.3 ROOF HOODS

- A. Hoods shall be constructed of roll formed, interlocking aluminum panels. Vertical end panels are fully locked into hood.
- B. Top of curb to hood inlet shall be minimum of 5" .
- C. Curb cap shall be of 14 gauge formed aluminum with mitered corners continuously heliarc-welded. Hood shall be of the same material and cross-braced for added strength..
- D. Hoods shall be furnished with aluminum bird screen.
- E. Hood and throat shall be reinforced with extruded aluminum angle and have a minimum snow load rating of 30 lbs. per square foot.
- F. Size, cfm, finish and pressure drop for hoods shall be as scheduled on the drawings.
- G. Inlet area shall be minimum 150% of throat area for intake hoods. Outlet area shall be minimum 125% of throat area for exhaust hoods and relief vents.

- H. Hoods shall be furnished with 12" high curb (above top of roof) and be of the size and type as shown on the drawings.
- I. Hood shall be furnished with motorized damper unless otherwise noted on the drawings.
- J. Manufacturers:
  - 1. Cook
  - 2. Greenheck
  - 3. PennBarry
  - 4. Twin City Fan & Blower

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. General Installation Requirements:
  - 1. Install items in accordance with manufacturers' instructions.
  - 2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
  - 3. Install diffusers to ductwork with air tight connections.
  - 4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
  - 5. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.
- B. Volume Damper:
  - 1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.
- C. Roof Hood and Louvered Penthouse:
  - 1. If manufacturer has no recommendations, secure roof hoods and louvered penthouses to curbs with 1/4" lag bolts on 8" maximum centers.
  - 2. Provide 20 gauge sheet metal duct blank-off behind louvers at unused portions of louver openings in exterior walls. Back with 2" rigid 3# density fiberglass board insulation with foil scrim facing the room. Seal watertight.

END OF SECTION

**SECTION 235416.13 - GAS-FIRED FURNACES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Gas-fired, condensing furnaces and accessories complete with controls.
  - 2. Refrigeration components.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

**PART 2 - PRODUCTS****2.1 GAS-FIRED FURNACES, CONDENSING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Arcoaire Air Conditioning & Heating; an International Comfort Products brand; a unit of United Technologies Corp.
  - 2. Carrier Corporation; a unit of United Technologies Corp.
  - 3. Lennox Industries, Inc.; Lennox International.
  - 4. Trane.
  - 5. YORK; a Johnson Controls company.
  - 6. Daikin.
- B. Cabinet: Steel.
  - 1. Cabinet interior around heat exchanger shall be factory-installed insulation.
  - 2. Lift-out panels shall expose burners and all other items requiring access for maintenance.
  - 3. Factory paint external cabinets in manufacturer's standard color.

- C. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
- D. Type of Gas: Natural.
- E. Heat Exchanger:
  - 1. Primary: Stainless steel.
  - 2. Secondary: Stainless steel.
- F. Burner:
  - 1. Gas Valve: 100 percent safety modulating main gas valve, main shutoff valve, pressure regulator, safety pilot with electronic flame sensor, limit control, transformer, and combination ignition/fan timer control board.
  - 2. Ignition: Electric pilot ignition, with hot-surface igniter or electric spark ignition.
- G. Gas-Burner Safety Controls:
  - 1. Electronic Flame Sensor: Prevents gas valve from opening until pilot flame is proven; stops gas flow on ignition failure.
  - 2. Flame Rollout Switch: Installed on burner box; prevents burner operation.
  - 3. Limit Control: Fixed stop at maximum permissible setting; de-energizes burner on excessive bonnet temperature; automatic reset.
- H. Combustion-Air Inducer: Centrifugal fan with thermally protected motor and sleeve bearings prepurges heat exchanger and vents combustion products; pressure switch prevents furnace operation if combustion-air inlet or flue outlet is blocked.
- I. Furnace Controls: Solid-state board integrates ignition, heat, cooling, and fan speeds; adjustable fan-on and fan-off timing; terminals for connection to accessories; diagnostic light with viewport.

## 2.2 REFRIGERATION COMPONENTS

- A. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with AHRI 210/240. Match size with furnace. Include condensate drain pan with accessible drain outlet complying with ASHRAE 62.1.
  - 1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.



**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 factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
- C. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
- D. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

**3.3 PIPING CONNECTIONS**

- A. Gas piping installation requirements are specified in Section 231123 "Facility Natural-Gas Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.

**3.4 DUCTWORK CONNECTIONS**

- A. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."

**3.5 ELECTRICAL CONNECTIONS**

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "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 260553 "Identification for Electrical Systems."

**3.6 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

**3.7 STARTUP SERVICE**

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
  - 1. Inspect for physical damage to unit casings.
  - 2. Verify that access doors move freely and are weathertight.
  - 3. Clean units and inspect for construction debris.
  - 4. Verify that all bolts and screws are tight.
  - 5. Adjust vibration isolation and flexible connections.
  - 6. Verify that controls are connected and operational.
- B. Adjust fan belts to proper alignment and tension.
- C. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- D. Measure and record airflows.
- E. Verify proper operation of capacity control device.

**3.8 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

**3.9 CLEANING**

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

END OF SECTION 235416.13

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**SECTION 235533.16 - GAS-FIRED UNIT HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes gas-fired unit heaters.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of gas-fired unit heater.
  - 1. Include rated capacities, operating characteristics, and accessories.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B.
  - 1. Lennox International, Inc; Lennox International.
  - 2. Modine Manufacturing Company.
  - 3. Reznor/Thomas & Betts Corporation.
  - 4. Sterling HVAC Products; Div. of Mestek Technology Inc.
  - 5. Trane; a brand of Ingersoll Rand.

**2.2 MANUFACTURED UNITS**

- A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- C. Type of Venting: Gravity vented. AL29-4C material.

- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
  - 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
  - 2. Discharge Louvers: Independently adjustable, horizontal blades.
  - 3. Discharge Nozzle: Discharge at 25 to 65 degrees from horizontal.
- E. Accessories:
  - 1. Four-point suspension kit.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Propeller Unit Fan:
  - 1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
  - 2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
- I. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
  - 1. Gas Control Valve: Single stage.
  - 2. Ignition: Electronically controlled electric spark with flame sensor.
  - 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  - 4. Vent Flow Verification: Flame rollout switch.
  - 5. Control transformer.
  - 6. High Limit: Thermal switch or fuse to stop burner.
  - 7. Unit-Mounted Thermostat:
    - a. Single stage.
    - b. Fan on-off-automatic switch.
    - c. 24-V ac.
    - d. 50 to 90 deg F operating range.
- J. Electrical Connection: Factory wire motors and controls for a single electrical connection.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written instructions.

**3.2 EQUIPMENT MOUNTING**

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

**3.3 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 gas-fired unit heater, allow space for service and maintenance.
- C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

**3.4 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

END OF SECTION 235533.16

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SECTION 237223.19 - INDOOR FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Fixed-plate, total heat exchangers in packaged, indoor, energy-recovery units.

1.3 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- B. ASHRAE Compliance:
  - 1. Applicable requirements in ASHRAE 62.1.
  - 2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. UL Compliance:
  - 1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.
- E. Comply with ASTM E84.

**2.2 PACKAGED, INDOOR, FIXED-PLATE TOTAL ENERGY RECOVERY UNITS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carnes Company.
  - 2. Greenheck Fan Corporation.
  - 3. Multistack, LLC.
  - 4. RenewAire LLC.
  - 5. Systemair USA.
  - 6. Source Limitations: Obtain from single source from single manufacturer.
- B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1- inch- thick thermal insulation, knockouts for electrical connections, exterior drain connection, and lifting lugs.
- D. Fixed-Plate Total Heat Exchanger:
  - 1. Casing: Galvanized steel.
  - 2. Plates: Evenly spaced and sealed and arranged for counter- flow.
    - a. Plate Material: Chemically treated paper or polymer membrane with selective hydroscopicity and moisture permeability, and gas barrier properties.
  - 3. Bypass Plenum: Within casing, with gasketed face-and-bypass dampers having operating rods extended outside casing.
- E. Supply and Exhaust Fans: Forward-curved centrifugal fan with spring isolators of 1- inch static deflection.
  - 1. Motor and Drive: Direct driven.
  - 2. 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.
- F. Filters:
  - 1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
  - 2. UL Compliance: Comply with UL 900.
  - 3. Media: Interlaced glass fibers sprayed with nonflammable adhesive[ and antimicrobial agent].
  - 4. Filter Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.



- 5. Filter Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
- G. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.
  - 1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
  - 2. Include nonfused disconnect switches.

### 2.3 SOURCE QUALITY CONTROL

- 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. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060.
- C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.
- D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP). Air-handling unit fan sound ratings shall comply with AMCA 301 or AHRI 260 (IP).
- E. UL Compliance:
  - 1. Packaged fixed plate energy recovery units shall comply with requirements in UL 1812; or UL 1815.
  - 2. Electric Coils: Comply with UL 1995.

## 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 packaged, indoor, fixed-plate, energy-recovery unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install packaged, indoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.
  - 1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
  - 2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
  - 3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."
- B. Suspended Units: Suspend units from structural-steel support frame, using threaded steel rods and spring hangers. Comply with requirements for vibration-isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Install units with clearances 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.

**3.3 ELECTRICAL CONNECTIONS**

- A. Install electrical devices furnished with units but not factory mounted.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Install electrical devices furnished by manufacturer, but not factory mounted, according to 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 260553 "Identification for Electrical Systems."

**3.4 CONTROL CONNECTIONS**

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5      STARTUP SERVICE

A.      Perform startup service.

1.      Complete installation and startup checks according to manufacturer's written instructions.

3.6      ADJUSTING

A.      Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B.      Adjust initial temperature and humidity setpoints.

C.      Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 237223.19

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SECTION 238129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: VRF HVAC systems.
  - 1. Indoor, concealed, floor-mounted units for ducting.
  - 2. Outdoor, air-source heat-pump units.
  - 3. System controls.
  - 4. System refrigerant and oil.
  - 5. System condensate drain piping.
  - 6. System refrigerant piping.
  - 7. Metal hangers and supports.
  - 8. Pipe stands.
  - 9. Outdoor equipment stands.
  - 10. Piping and tubing insulation.

1.2 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.
- C. 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.
- D. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- E. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.
- F. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.

- G. VRF: Variable refrigerant flow.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For VRF HVAC system components.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
  - 4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
  - 5. Include system operating sequence of operation in narrative form for each unique indoor- and outdoor-unit control.
  - 6. Include description of control software features.
  - 7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
  - 8. Include refrigerant type and data sheets showing compliance with requirements indicated.
  - 9. Indicate location and type of service access.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
    - a. Retain copies of Installer certificates on-site and make available on request.
  - 2. For VRF HVAC system manufacturer.
  - 3. For VRF HVAC system provider.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
  - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
  - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

## PART 2 - PRODUCTS

### 2.1 VRF HVAC SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Daikin Applied.
  - 2. LG Electronics USA, Inc.; LG Electronics Inc.
  - 3. Mitsubishi Electric & Electronics USA, Inc.
  - 4. Trane Inc.
- B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:
  - 1. Indoor and outdoor units, including accessories.
  - 2. Controls and software.
  - 3. HRCUs.
  - 4. Refrigerant isolation valves.
  - 5. Specialty refrigerant pipe fittings.

### 2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
  - 1. Two-pipe or three-pipe system design.
  - 2. System(s) operation, heat pump as indicated on Drawings.
  - 3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- 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. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.
- D. ASHRAE Compliance:
  - 1. ASHRAE 15: For safety code for mechanical refrigeration.
  - 2. ASHRAE 62.1: For indoor air quality.
  - 3. ASHRAE 135: For control network protocol with remote communication.
  - 4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Service Access:
  - 1. Provide and document service access requirements.
  - 2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
  - 3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
  - 4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
  - 5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
  - 6. Comply with OSHA regulations.
- B. System Design and Installation Requirements:
  - 1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
  - 2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- C. Isolation of Equipment: Provide isolation valves to isolate each indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- D. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
  - 1. As scheduled on drawings.
- E. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.

- F. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.
- G. Outdoor Conditions:
  - 1. Suitable for outdoor ambient conditions encountered.
  - 2. Maximum System Operating Outdoor Temperature: See Drawings.
  - 3. Minimum System Operating Outdoor Temperature: See Drawings.
- H. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.
- I. Capacities and Characteristics: As indicated on Drawings.

**2.4 INDOOR, CONCEALED, FLOOR-MOUNTED UNITS FOR DUCTING**

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
- B. Cabinet:
  - 1. Material: Galvanized or painted steel.
  - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  - 3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
  - 4. Mounting: Manufacturer-designed provisions for field installation.
  - 5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
  - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
  - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
  - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
  - 5. Unit Internal Tubing: Copper tubing with brazed joints.
  - 6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  - 7. Field Piping Connections: Manufacturer's standard.
  - 8. Factory Charge: Dehydrated air or nitrogen.
  - 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:



1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
  2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
  3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
1. Fan(s):
    - a. Direct-drive arrangement.
    - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    - c. Materials: Non-ferrous components or ferrous components with corrosion resistant finish.
    - d. Statically and dynamically balanced.
  2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
  3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
  5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
  2. Efficiency: ASHRAE 52.2, MERV 7.
  3. Media:
    - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
- G. Unit Accessories:
1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
- H. Unit Controls:
1. Enclosure: Metal, suitable for indoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors:
    - a. Unit inlet air temperature.
    - b. Coil entering refrigerant temperature.
    - c. Coil leaving refrigerant temperature.
  4. Features and Functions:

- a. Self-diagnostics.
  - b. Time delay, auto-restart.
  - c. External static pressure control.
  - d. Auto operation mode.
  - e. Manual operation mode.
  - f. Filter service notification.
  - g. Power consumption display.
  - h. Drain assembly high water level safety shutdown and notification.
  - i. Run test switch.
5. Communication: Network communication with other indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

## 2.5 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
  1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
  2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
  3. All units installed shall be from the same product development generation.
- B. Cabinet:
  1. Galvanized steel and coated with a corrosion-resistant finish.
    - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
  2. Mounting: Manufacturer-designed provisions for field installation.
  3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
  1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
  2. Protection: Integral protection against the following:
    - a. High refrigerant pressure.
    - b. Low oil level.

- c. High oil temperature.
    - d. Thermal and overload.
    - e. Voltage fluctuations.
    - f. Phase failure and phase reversal.
    - g. Short cycling.
  - 3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
  - 4. Vibration Control: Integral isolation to dampen vibration transmission.
  - 5. Oil management system to ensure safe and proper lubrication over entire operating range.
  - 6. Crankcase heaters with integral control to maintain safe operating temperature.
  - 7. Fusible plug.
- D. Condenser Coil Assembly:
- 1. Plate Fin Coils:
    - a. Casing: Aluminum, galvanized, or stainless steel.
    - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
    - c. Tubes: Copper, of diameter and thickness required by performance.
  - 2. Aluminum Microchannel Coils:
    - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
    - b. Single- or multiple-pass arrangement.
    - c. Construct fins, tubes, and header manifolds of aluminum alloy.
  - 3. Coating: Corrosion resistant.
  - 4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
- 1. Fan(s): Propeller type.
    - a. Direct-drive arrangement.
    - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
    - c. Statically and dynamically balanced.
  - 2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
  - 3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
  - 4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.

5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
  6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors:
    - a. Refrigerant suction temperature.
    - b. Refrigerant discharge temperature.
    - c. Outdoor air temperature.
    - d. Refrigerant high pressure.
    - e. Refrigerant low pressure.
    - f. Oil level.
  4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode.
  5. Communication: Network communication with indoor units and other outdoor unit(s).
  6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
  2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.

3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

## 2.6 SYSTEM CONTROLS

### A. General Requirements:

1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a manufacturer-selected control network.
2. Network Communication Protocol: Manufacturer proprietary control communication between interconnected units.
3. Operator Interface:
  - a. Operators shall interface with system and unit controls through the following:
    - 1) Operator interfaces integral to controllers.
  - b. Users shall be capable of interface with controllers for indoor units control to extent privileges are enabled. Control features available to users shall include the following:
    - 1) On/off control.
    - 2) Temperature set-point adjustment.

### B. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
  - a. Sets schedule for daily, weekly, and annual events.
  - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.

9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel.

C. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. On/Off: Turns indoor unit on or off.
4. Hold: Hold operation settings until hold is released.
5. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
6. Temperature Display: 1-degree increments.
7. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between .
8. Relative Humidity Display: 1 percent increments.
9. Fan Speed Setting: Select between available options furnished with the unit.
10. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
11. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
12. Occupancy detection.
13. Service Run Tests: Limit use by service personnel to troubleshoot operation.
14. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
15. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
16. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
17. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

2.7 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. R-410a.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

**2.8 SYSTEM CONDENSATE DRAIN PIPING**

- A. If more than one material is listed, material selection is Contractor's option.
- B. Copper Tubing:
  - 1. Drawn-Temper Tubing: According to ASTM B88, Type L or Type DWV according to ASTM B306.
  - 2. Wrought-Copper Fittings: ASME B16.22.
  - 3. Wrought-Copper Unions: ASME B16.22.
  - 4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

**2.9 SYSTEM REFRIGERANT PIPING**

- A. Refrigerant Piping:
  - 1. Copper Tube: ASTM B280, Type ACR.
  - 2. Wrought-Copper Fittings: ASME B16.22.
  - 3. Brazing Filler Metals: AWS A5.8/A5.8M.
- B. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.
- C. Refrigerant Isolation Ball Valves:
  - 1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
  - 2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
  - 3. Valve Connections: Flare or sweat depending on size.

**2.10 METAL HANGERS AND SUPPORTS**

- A. Copper 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 galvanized or copper-coated steel.

**2.11 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. MIRO Industries.
    - b. PHP Systems/Design.
    - c. RectorSeal HVAC; a CSW Industrials Company.
    - d. Rooftop Support Systems; Eberl Iron Works, Inc.
  - 2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  - 4. Hardware: Galvanized steel or polycarbonate.
  - 5. Accessories: Protection pads.

**2.12 OUTDOOR EQUIPMENT STANDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. MIRO Industries.
  - 2. RectorSeal HVAC; a CSW Industrials Company.
  - 3. Rooftop Support Systems; Eberl Iron Works, Inc.
- B. 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.
- C. Foot Material: Rubber or polypropylene.
- D. Rails Material: Hot-dip galvanized carbon steel.

**2.13 PIPING AND TUBING INSULATION**

- A. Condensate Drain Piping and Tubing Insulation and Jacket Requirements:
  - 1. Flexible Elastomeric Insulation:



- a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
  - b. Indoors: 1/2 inch thick.
- B. Refrigerant Tubing Insulation and Jacket Requirements:
  - 1. Flexible Elastomeric Insulation:
    - a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
    - b. Indoors: 1 inch thick.
    - c. Outdoors: 1 inch thick.
  - 2. Field-Applied Jacket:
    - a. Concealed: None required.
    - b. Outdoors or Indoors, Exposed to View: Aluminum, smooth, 0.020 inch thick.
- C. Flexible Elastomeric Insulation Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- D. Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.

## 2.14 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

## 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 products before installation. Reject products that are wet, moisture damaged, or mold damaged.

- C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
- D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.
- E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
- F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EQUIPMENT INSTALLATION, GENERAL

- A. Clearance:
  - 1. Maintain manufacturer's recommended clearances for service and maintenance.
  - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
  - 1. Loose components shall be installed by system Installer under supervision of manufacturer's service representative.

### 3.3 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

- F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- G. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
- H. Install floor-mounted units on support structure indicated on Drawings.
- I. Attachment: Install hardware for proper attachment to supported equipment.
- J. Grouting: Place grout under equipment supports and make bearing surface smooth.

### 3.4 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 2. Grouting: Place grout under equipment supports and make bearing surface smooth.

### 3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors.
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors.

### 3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

#### A. General Requirements for Drain Piping and Tubing:

- 1. Install a union in piping at each threaded unit connection.
- 2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
- 3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
  - a. Details indicated on Drawings.
  - b. Manufacturer's requirements.
  - c. Governing codes.
  - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
- 4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
- 5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

#### B. Gravity Drains:

- 1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

#### C. Pumped Drains:

- 1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

### 3.7 INSTALLATION OF REFRIGERANT PIPING

#### A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
  2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
  3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.
- B. Install refrigerant piping according to ASHRAE 15 and governing codes.
- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
  2. Install horizontal suction lines with a uniform slope downward to compressor.
  3. Install traps to entrain oil in vertical runs.
  4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Joint Construction:
1. Ream ends of tubes and remove burrs.
  2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
  3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
    - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
    - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

**3.8 INSTALLATION OF METAL HANGERS AND SUPPORTS**

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- C. Comply with MFMA-103 for metal framing system selections and applications that are not specified.
- D. Fastener System Installation:
  - 1. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- E. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. 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.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel.
  - 1. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. 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.
- L. Piping and Tubing Insulation:
  - 1. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - 2. 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.
- M. Horizontal-Piping Hangers and Supports: 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. 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.
  - 3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 4. Multiple horizontal pipes located indoors may use metal framing systems with split clamp attachment for each pipe in lieu of individual clevis hangers.
  - 5. Pipe stands for horizontal pipes located outdoors.
  - 6. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  - 7. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- N. Horizontal Piping Hanger Spacing and Rod Size: Install hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:
- 1. Sizes through NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- O. Vertical-Piping Clamps: Install the following types:
- 1. Extension Pipe or Riser Clamps (MSS Type 8).
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): If longer ends are required for riser clamps.
- P. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified.
- Q. Use hangers, supports, and attachments with galvanized coatings unless otherwise indicated.
- R. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- S. Trim excess length of continuous-thread hanger and support rods to 1 inch.
- T. Hanger-Rod Attachments: 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. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

U. Building Attachments: 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.
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.

### 3.9 INSTALLATION OF PIPING AND TUBING 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. Installation to maintain a continuous vapor barrier.
- B. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of 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.



- C. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are unavailable, 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. 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.
- 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.

**3.10 INSTALLATION OF DUCT, ACCESSORIES, AND AIR OUTLETS**

- A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
- B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
- C. Comply with requirements for nonmetal ducts specified in Section 233116 "Nonmetal Ducts."
- D. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
- E. Comply with requirements for flexible ducts specified in Section 233346 "Flexible Ducts."

**3.11 ELECTRICAL CONNECTIONS**

- A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.
- B. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
- C. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- D. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.
- E. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated phenolic layers of black with engraved white letters. Letters at least 1/2 inch high.
2. Locate nameplate or label where easily visible.

- F. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or revised in this Section.
- G. Install manufactured conduit sweeps and long-radius elbows if possible.
- H. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

### 3.12 GROUNDING INSTALLATION

- A. For low-voltage control cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.13 IDENTIFICATION

- A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."
- B. Identify system electrical and controls components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
1. Identify each control cable on each end and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.

### 3.14 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.
1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
  2. Final Inspection before Startup:
    - a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.

- b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
- c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
- d. Inspection reports for indoor units shall include, but not be limited to, the following:
  - 1) Unit designation on Drawings.
  - 2) Manufacturer model number.
  - 3) Serial number.
  - 4) Network address, if applicable.
  - 5) Each equipment setting.
  - 6) Mounting, supports, and restraints properly installed.
  - 7) Proper service clearance provided.
  - 8) Wiring and power connections correct.
  - 9) Line-voltage reading(s) within acceptable range.
  - 10) Wiring and controls connections correct.
  - 11) Low-voltage reading(s) within an acceptable range.
  - 12) Controller type and model controlling unit.
  - 13) Controller location.
  - 14) Temperature settings and readings within an acceptable range.
  - 15) Humidity settings and readings within an acceptable range.
  - 16) Condensate removal acceptable.
  - 17) Fan settings and readings within an acceptable range.
  - 18) Unit airflow direction within an acceptable range.
  - 19) If applicable, fan external static pressure setting.
  - 20) Filter type and condition acceptable.
  - 21) Noise level within an acceptable range.
  - 22) Refrigerant piping properly connected and insulated.
  - 23) Condensate drain piping properly connected and insulated.
  - 24) If applicable, ductwork properly connected.
  - 25) If applicable, external interlocks properly connected.
  - 26) Remarks.
- e. Inspection reports for outdoor units shall include, but not be limited to, the following:
  - 1) Unit designation on Drawings.
  - 2) Manufacturer model number.
  - 3) Serial number.
  - 4) Network address, if applicable.
  - 5) Each equipment setting.
  - 6) Mounting, supports, and restraints properly installed.
  - 7) Proper service clearance provided.
  - 8) Wiring and power connections correct.
  - 9) Line-voltage reading(s) within acceptable range.

- 10) Wiring and controls connections correct.
  - 11) Low-voltage reading(s) within an acceptable range.
  - 12) Condensate removal acceptable.
  - 13) Noise level within an acceptable range.
  - 14) Refrigerant piping properly connected and insulated.
  - 15) Condensate drain piping properly connected and insulated.
  - 16) Remarks.
- f. Inspection reports for indoor, dedicated outdoor air ventilation units shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
  - 2) Manufacturer model number.
  - 3) Serial number.
  - 4) Network address, if applicable.
  - 5) Each equipment setting.
  - 6) Mounting, supports, and restraints properly installed.
  - 7) Proper service clearance provided.
  - 8) Wiring and power connections correct.
  - 9) Line-voltage reading(s) within acceptable range.
  - 10) Wiring and controls connections correct.
  - 11) Low-voltage reading(s) within an acceptable range.
  - 12) Controller type and model controlling unit.
  - 13) Controller location.
  - 14) Temperature settings and readings within an acceptable range.
  - 15) Humidity settings and readings within an acceptable range.
  - 16) Condensate removal acceptable.
  - 17) Fan settings and readings within an acceptable range.
  - 18) Fan external static pressure setting.
  - 19) Filter type and condition acceptable.
  - 20) Noise level within an acceptable range.
  - 21) Refrigerant piping properly connected and insulated.
  - 22) Condensate drain piping properly connected and insulated.
  - 23) Automatic dampers properly installed and operating.
  - 24) Ductwork properly connected.
  - 25) If applicable, external interlocks properly connected.
  - 26) Remarks.
- g. Inspection reports for energy recovery ventilators shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
  - 2) Manufacturer model number.
  - 3) Serial number.
  - 4) Network address, if applicable.
  - 5) Each equipment setting.
  - 6) Mounting, supports, and restraints properly installed.
  - 7) Proper service clearance provided.

- 8) Wiring and power connections correct.
  - 9) Line-voltage reading(s) within acceptable range.
  - 10) Wiring and controls connections correct.
  - 11) Low-voltage reading(s) within an acceptable range.
  - 12) Controller type and model controlling unit.
  - 13) Controller location.
  - 14) Temperature settings and readings within an acceptable range.
  - 15) Humidity readings.
  - 16) Condensate removal acceptable.
  - 17) Fan settings and readings within an acceptable range.
  - 18) Fan external static pressure setting.
  - 19) Filter type and condition acceptable.
  - 20) Noise level within an acceptable range.
  - 21) Automatic dampers properly installed and operating.
  - 22) Ductwork properly connected.
  - 23) If applicable, external interlocks properly connected.
  - 24) Remarks.
- h. Inspection reports for hydronic units shall include, but not be limited to, the following:
- 1) Unit designation on Drawings.
  - 2) Manufacturer model number.
  - 3) Serial number.
  - 4) Network address, if applicable.
  - 5) Each equipment setting.
  - 6) Mounting, supports, and restraints properly installed.
  - 7) Proper service clearance provided.
  - 8) Wiring and power connections correct.
  - 9) Line-voltage reading(s) within acceptable range.
  - 10) Wiring and controls connections correct.
  - 11) Low-voltage reading(s) within an acceptable range.
  - 12) Controller type and model controlling unit.
  - 13) Controller location.
  - 14) Temperature settings and readings within an acceptable range.
  - 15) Condensate removal acceptable.
  - 16) Noise level within an acceptable range.
  - 17) Refrigerant piping properly connected and insulated.
  - 18) Hydronic piping properly connected and insulated.
  - 19) Proof of water flow checked for proper operation.
  - 20) Condensate drain piping properly connected and insulated.
  - 21) If applicable, external interlocks properly connected.
  - 22) Remarks.
- i. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
- j. Installer shall correct observed deficiencies found by the inspection.

- k. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
  - l. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
  - m. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.
- B. Perform the following tests and inspections with the assistance of manufacturer's service representative:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 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. Refrigerant Tubing Positive Pressure Testing:
  - 1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
  - 2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.5 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
  - 3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
  - 4. Prepare test report to record the following information for each test:
    - a. Name of person starting test, company name, phone number, and e-mail address.
    - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    - c. Detailed description of extent of tubing tested.
    - d. Date and time at start of test.
    - e. Test pressure at start of test.
    - f. Outdoor temperature at start of test.
    - g. Name of person ending test, company name, phone number, and e-mail address.
    - h. Date and time at end of test.
    - i. Test pressure at end of test.
    - j. Outdoor temperature at end of test.
    - k. Remarks:
  - 5. Submit test reports for Project record.

**D. Refrigerant Tubing Evacuation Testing:**

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour(s) with no change.
4. Prepare test report to record the following information for each test:
  - a. Name of person starting test, company name, phone number, and e-mail address.
  - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
  - c. Detailed description of extent of tubing tested.
  - d. Date and time at start of test.
  - e. Test pressure at start of test.
  - f. Outdoor temperature at start of test.
  - g. Name of person ending test, company name, phone number, and e-mail address.
  - h. Date and time at end of test.
  - i. Test pressure at end of test.
  - j. Outdoor temperature at end of test.
  - k. Remarks:
5. Submit test reports for Project record.
6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

**E. System Refrigerant Charge:**

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

**F. Products will be considered defective if they do not pass tests and inspections.**

**G. Prepare test and inspection reports.**

**3.15 STARTUP SERVICE**

- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.**

1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
  2. Complete startup service of each separate system.
  3. Complete system startup service according to manufacturer's written instructions.
- B. Startup checks shall include, but not be limited to, the following:
1. Check control communications of equipment and each operating component in system(s).
  2. Check each indoor unit's response to demand for cooling and heating.
  3. Check each indoor unit's response to changes in airflow settings.
  4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
- C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
1. Installer shall correct deficiencies found during startup service for reverification.
- D. System Operation Report:
1. After completion of startup service, manufacturer shall issue a report for each separate system.
  2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
  3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.
    - a. All available system operating parameters shall be included in the information submitted.
- E. Witness:
1. Invite Engineer to witness startup service procedures.
  2. Provide written notice not less than 20 business days before start of startup service.
- 3.16 ADJUSTING
- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
  - B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
  - C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.



- D. 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.

**3.17 PROTECTION**

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.
- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

**3.18 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include two service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

**3.19 DEMONSTRATION**

- A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.

**END OF SECTION**

**SECTION 238239.19 - WALL AND CEILING UNIT HEATERS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and 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 details of anchorages and attachments to structure and to supported equipment.
  - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Wiring Diagrams: Power, signal, and control wiring.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS****2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko; Marley Engineered Products.
2. Chromalox, Inc.
3. INDEECO.
4. Marley Engineered Products.
5. QMark; Marley Engineered Products.
6. Trane.
7. TPI Corporation.

## 2.2 DESCRIPTION

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- 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 CABINET

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

## 2.4 COIL

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

## 2.5 FAN AND MOTOR

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238239.19

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**SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS****PART 1 - GENERAL****1.1 WORK INCLUDED**

- A. The General and Supplemental General Conditions of the Contract and Division 1 of the specifications shall apply to this Division.
- B. This Section 260100 shall be part of each section of Division 26 - Electrical.

**1.2 RELATED WORK**

- A. All sections of Division 26 - Electrical.
- B. All sections of Division 1 - 48.
- C. All addenda issued.
- D. The complete installation of the electrical systems as indicated on the drawings, including details not specifically mentioned or shown that may be necessary to complete the systems.

**1.3 QUALITY ASSURANCE**

- A. Conform to the Uniform Building Codes.
- B. Conform to the State Building Codes.
- C. Conform to the Local Building Codes.
- D. Conform to the National Fire Protection Association.
- E. Conform to the State Fire Codes.
- F. Conform to the Local Fire Codes.
- G. Conform to the State Health Department.
- H. Conform to the Local Utility Company (gas, water, sewer, storm sewer and electric) Rules and Regulations.
- I. Conform to the National Electric Code.

- J. These codes, rules and regulations shall take precedence if the drawings and specifications are not in conformance therewith, except that where the drawings and specifications exceed minimum code requirements the drawings and specifications shall take precedence.

#### 1.4 SUBMITTALS

- A. Refer to front portion of the specifications.
- B. Submit minimum of one (1) electronic copy or more if specified in another section, of shop drawings and product data on all electrical equipment to be provided by the Contractor.
- C. Title each drawing with project name and number; identify each element of drawings by reference to sheet number and detail, schedule or room number of Contract Documents.
- D. Sequentially number submittals according their specification section number. Revised submittals should include original number and a sequential alphabetic suffix.
- E. Contractor and supplier shall review and stamp and sign submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturers catalog numbers and conformance of submittal with requirements of Contract Documents. Identify in writing at time of submittal of any deviations from requirements of Contract Documents.
- F. Mark dimensions and values in units to match those specified.
- G. Do not fabricate or order products or begin work that requires submittals until approval of submittal.
- H. Approval of equipment does not construe approval of equipment, components, etc., that no information is furnished to show compliance with contract documents.

#### 1.5 SCOPE OF THE WORK

- A. The work covered by this specification shall include all labor, material, equipment and services necessary for and reasonably incidental to proper completion of all electrical work as shown on the drawings and hereinafter specified, except work or material specified to be furnished and performed by others. The work shall include but not be limited to the following:
  - 1. Electrical service.
  - 2. Electrical equipment, materials and work, connection of pumps, and miscellaneous equipment.

#### 1.6 CHANGE ORDERS

- A. Refer to front portion of the specifications.

- B. The Contractor shall, in no instance, commence work on or provide materials for or make changes in, the work for this project which will require additional payment from the Owner to the Contractor until he has requested and obtained, in writing, either a signed written Change Order or a signed written notice to proceed with the extra work.
- C. Each request for approval of additional work that is to require additional payment from the Owner or in instances where credit is to be allowed to the Owner for omission of certain work or materials, shall be accompanied by a price quotation, including a complete cost breakdown of materials, labor, overhead and profit.

#### 1.7 AS-BUILT DRAWINGS

- A. Refer to front portion of the specifications.
- B. This Contractor shall prepare as-built drawings for the various component portions of the electrical installations. These drawings shall be furnished to the Owner after completion of the work. These drawings shall be prepared by marking up a set of contract drawings with colored pencils to show changes made during construction after the various installations have been completed.
- C. At completion of project, Contractor shall provide equipment identification as directed in Section 260553.

#### 1.8 PERMITS, LICENSES AND FEES

- A. The Contractor shall familiarize himself with all requirements as to permits, licenses, fees, codes and ordinances and arrange to comply with them. All permits, licenses, fees and inspections required for the work under this Contract shall be obtained and paid for by the Contractor unless otherwise specified.

#### 1.9 DATA AND MEASUREMENTS

- A. The information given herein and on the drawings is as exact as could be secured, but its extreme accuracy is not guaranteed. The Electrical Contractor must examine the locations carefully and verify all measurements, distances, levels, conduit, wire sizes, obstructions, remodeling work, work of other trades, etc., before submitting bids and before starting work. The Contractor shall satisfactorily adapt his work to the actual conditions at the building.
- B. Electrical drawings are of small scale, it is not possible to show all necessary conduit, junction boxes, fittings and accessories. Furnish items as necessary for completion. Examine drawings and specifications and obtain exact locations, measurements, levels, etc. at site for placement of equipment.

**1.10 COORDINATION OF WORK**

- A. Refer to front portion of the specifications.
- B. The Contractor shall plan all work so that it proceeds with a minimum of interference between trades. It shall also be the responsibility of the Contractor to provide all openings required in the building construction for the installation of electrical work. Provisions shall be made for all special frames, openings and pipe sleeves as required. The Contractor shall do all extra cutting and patching made necessary by his failure to properly direct such work at the correct time.

**1.11 QUALIFICATIONS OF INSTALLERS**

- A. Refer to front portion of the specifications.
- B. All work shall be performed by worker skilled in the respective trade required by each part of the work. Helpers and apprentices used for any part of the work shall be under the full supervision of a thoroughly trained and skilled worker of the trade required for that part of the work. No allowance will be made for lack of skill in the acceptance or rejection of any work.

**1.12 QUALITY OF WORK**

- A. All work shall be of the best quality free from defects in workmanship, materials and performance.

**1.13 GUARANTEE**

- A. Refer to front portion of the specifications.
- B. The Contractor shall guarantee that all electrical systems shall be free from defects in workmanship, materials and performance and that if such defects shall appear during a period of one year or as specified in another section, from date of final acceptance, he will remedy such defects to the satisfaction of the Owner at no extra cost.

**1.14 PROJECT/SITE CONDITIONS**

- A. Install work in locations shown on drawings, unless prevented by project conditions.
- B. Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes in work specified in other sections. Obtain permission of engineer before proceeding.



**1.15 PACKING, TRANSPORTATION**

- A. Require supplier to package finished products in boxes or crates for protection during shipment, handling and storage. Protect sensitive products against exposure to elements and moisture.
- B. Protect sensitive equipment and finishes against impact, abrasion and other damage.

**1.16 DELIVERY AND RECEIVING**

- A. Arrange deliveries of products in accordance with construction progress schedules. Allow time for inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with work and conditions at site, work of other contractors, limitations on storage space, availability of personnel and handling equipment.
- C. Deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. Clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, inspect shipment to assure:
  - 1. Products comply with requirements of contract documents and reviewed submittals.
  - 2. Quantities are correct.
  - 3. Accessories and installation hardware are correct.
  - 4. Containers and packages are intact and labels legible.
  - 5. Products are protected and undamaged.

**1.17 PRODUCT HANDLING**

- A. Provide equipment and personnel to handle products, including those provided by Owner, by methods to prevent soiling and damage.
- B. Provide additional protection during handling to prevent marring and otherwise damaging products, packaging and surrounding surfaces.
- C. Handle product by methods to avoid bending or over stressing. Lift large and heavy components only at designated lift points.

**1.18 OPERATING AND MAINTENANCE MANUAL**

- A. Refer to front portion of the specifications and to each Section of Division 26 Electrical.

- B. The Contractor shall furnish three (3) Operating and Maintenance Manuals to the Owner after all tests and adjustments have been completed. Final payment will not be made until this manual has been submitted and approved. In addition to the requirements of Section 01700, The manual shall include, but is not limited to:
1. Name, Address and Telephone of the Manufacturer and Local Representative: Include a list of all suppliers and representatives of products supplied on the project shall be included in the manual.
  2. Manufacturers' Manuals and Parts Lists: Operating and maintenance manuals and parts lists furnished by equipment manufacturers shall be included in the manual.
  3. Manufacturers Start-up of Equipment Documentation: Documents shall include date and time of start-up, name of authorized personnel who performed start-up, any required settings and notes concerning start-up shall be included in the manual.
  4. State or City Tests, Approval or Acceptance of Equipment and/or systems: This shall include date, time, name of authorized personnel and any other notes. Documentation of domestic water sterilization and equipment approved installation start-ups shall be included in the manual.
  5. Shop Drawings: One copy of each approved shop drawing shall be included in the manual.
  6. Index: A complete index shall be included at the front of the manual.
  7. Binder: All of the above-described items shall be assembled in a three-ring binder with a hard cover and durable cloth or plastic finish.

#### 1.19 STORAGE, GENERAL

- A. Store products, immediately on delivery, in accordance with manufacturer's instructions, with seals and labels intact. Protect until installed.
- B. Arrange storage in a manner to provide access for maintenance of stored items and for inspection.

#### 1.20 CONFLICTS

- A. Conflicts between contract documents, codes ordinances or manufacturer's installation shall be brought to the attention of the Contracting Officer before installation for clarification.
- B. Conflicts not resolved prior to bid, the Contractor shall bid the larger quantity, more stringent or better quality of work.
- C. Where the codes or Utility Company requirements conflict with the drawings or specifications, the code shall have precedence only when it is more stringent than the item specified or shown. The item specified and/or shown on the drawings shall be followed when the item meets or exceed the required codes or Utility Company requirements.

**PART 2 - PRODUCTS****PART 3 - EXECUTION****3.1 TESTS AND ADJUSTMENTS**

- A. After completion of the work, but before final payment is made, the Contractor shall run a test over a sufficient period of time to prove the proper operation and performance of all apparatus, etc. and of the system as a whole.

**3.2 OPERATING INSTRUCTIONS**

- A. After all tests and adjustments are completed, the Contractor shall give complete operating and maintenance instructions to the Owner's operating personnel. The Operating and Maintenance Manual shall be used as the basis of instructions.
- B. The Contractor shall notify Owner and Engineer seven (7) days prior to instructions.

**3.3 CLEANING**

- A. The Contractor shall maintain all areas free from hazardous or obstructive rubbish and debris due to installation of the electrical work during construction. When the electrical systems have been installed, the Contractor shall remove all rubbish and debris resulting from his work from the building and site and remove all paint, plaster and accumulated dirt from all electrical equipment, fixtures and conduit.
- B. After all equipment has been installed, the electrical contractor shall remove all stickers, rust stain labels, temporary covers, plaster marks, paint spots, etc. All foreign matter shall be blown out or flushed out of all piping, fans, motors, devices, switches, panels, etc.
- C. Identification plates on all equipment shall be free of excess paint and shall be varnished.
- D. The Contractor shall leave the electrical portion of the work in a safe, clean and very neat condition ready for operation.
- E. At completion of project, Contractor shall provide equipment identifications as directed in Section 260553.

**3.4 PAINTING**

- A. All painting shall be done pursuant to front portion of the specifications.

- B. Damage and Touch-up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.5 EQUIPMENT INSTALLATION

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

### 3.6 ELECTRICAL WORK

- A. The Mechanical Contractor shall set in place all motors they are to furnish. All starters, switches, controls, etc., scheduled or provided with manufacturer equipment shall be turned over to the Electrical Contractor and they will be responsible for electrical connection.

### 3.7 UTILITY SERVICES

- A. Provide temporary services and utilities to allow for construction of facility prior to installation of electrical service as required.

END OF SECTION

SECTION 260150 - BASIC ELECTRICAL MATERIALS AND METHODS

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 the following:
  - 1. Concrete equipment bases.
  - 2. Electrical demolition.
  - 3. Cutting and patching for electrical construction.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  - 1. Set inserts and sleeves in poured-in-place concrete, masonry work and other structural components as they are constructed.
- B. Sequence, coordinate and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before installing doors or closing up openings.
- C. Coordinate electrical service connections to components provided by utility companies.

1. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

## **PART 2 - PRODUCTS**

### **2.1 CONCRETE BASES**

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

## **PART 3 - EXECUTION**

### **3.1 ELECTRICAL EQUIPMENT INSTALLATION**

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

### **3.2 WIRING INSTALLATION**

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. 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.

**3.3 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

**3.4 DEMOLITION**

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect and make operational components indicated for relocation.

**3.5 CUTTING AND PATCHING**

- A. Cut, channel, chase and drill floors, walls, partitions, ceilings and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

**3.6 CLEANING AND PROTECTION**

- A. On completion of installation, including outlets, fittings and devices, inspect exposed finish. Remove burrs, dirt, paint spots and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes and cabinets are without damage or deterioration at time of Substantial Completion.

# **BASIC ELECTRICAL MATERIALS AND METHODS**

LXT Eastside Development

## **SECTION 260150**

Project #47732472  
Permit Set 09/29/23

END OF SECTION



SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Tray cable, Type TC.
4. Fire-alarm wire and cable.
5. Connectors and splices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

B. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

C. Conductor Insulation:

1. Type THHN. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

**PART 3 - EXECUTION**

**3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders:
  - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
  - 2. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
  - 1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
  - 2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

**3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway .
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

**3.3 INSTALLATION, GENERAL**

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 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.
  - 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 inch of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "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.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

**LOW-VOLTAGE ELECTRICAL POWER  
CONDUCTORS AND CABLES**

LXT Eastside Development

**SECTION 260519**

Project #47732472  
Permit Set 09/29/23

END OF SECTION

SECTION 260526 - 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.

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 CONDUCTORS

- A. Insulated Conductors: 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 inch wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

## 2.3 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. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- C. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- D. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- E. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- F. Water Pipe Clamps:
  1. Mechanical type, two pieces with zinc-plated bolts.
    - a. Material: Die-cast zinc alloy.
    - b. Listed for direct burial.
  2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

## 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 ft..

## 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 inch below grade.
  2. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

- 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 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- 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 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode must be connected to the equipment grounding conductor and to the frame of the generator.

### 3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inch from the foundation.

### 3.5 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.
  - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- 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 system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.6 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 6 inch 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 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.
  - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. 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; if a disconnect-type connection is required, use a bolted clamp.
- 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 ft. apart.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 ft. of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 ft. 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.

END OF SECTION

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S raceways and elbows.
2. Type EPEC raceways and fittings.
3. Type ERMC-A and Type ERMC-SS raceways, elbows, couplings, and nipples.
4. Type FMC-S and Type FMC-A raceways.
5. Type FMT raceways.
6. Type IMC raceways.
7. Type LFMC raceways.
8. Type LFNC raceways.
9. Type PVC raceways and fittings.
10. Fittings for conduit, tubing, and cable.
11. Threaded metal joint compound.
12. Surface metal raceways and fittings.
13. Surface nonmetallic raceways.
14. Metallic outlet boxes, device boxes, rings, and covers.
15. Cover plates for device boxes.
16. Hoods for outlet boxes.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

PART 2 - PRODUCTS

2.1 TYPE EMT-S RACEWAYS AND ELBOWS

A. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:

- 1) Reference Standards: UL 797 and UL Category Control Number FJMX.
- 2) Exterior Coating: Zinc.
- 3) Interior Coating: Zinc with organic top coating.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.
- 2) Colors: As indicated on Drawings.

**2.2 TYPE EPEC RACEWAYS AND FITTINGS**

**A. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):**

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:

- 1) Reference Standards: UL 651A and UL Category Control Number EAZX.
- 2) Dimensional Specifications: Schedule 40.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

**B. Schedule 80 Electrical HDPE Underground Conduit (EPEC-80):**

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:

- 1) Reference Standards: UL 651A and UL Category Control Number EAZX.
- 2) Dimensional Specifications: Schedule 80.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

**2.3 TYPE FMC-S AND TYPE FMC-A RACEWAYS**

**A. Steel Flexible Metal Conduit (FMC-S):**

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
  - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
  - 2) Material: Steel.
- c. Options:
  - 1) Minimum Trade Size: 3/4 inch.
  - 2) Colors: As indicated on Drawings.

**B. Aluminum Flexible Metal Conduit (FMC-A):**

- 1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standard: UL 1 and UL Category Control Number DXUZ.
    - 2) Material: Aluminum.
  - c. Options:
    - 1) Minimum Trade Size: 3/4 inch.

**2.4 TYPE FMT RACEWAYS**

**A. Steel Flexible Metallic Tubing (FMT):**

- 1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standard: UL 1652 and UL Category Control Number ILJW.
  - c. Options:
    - 1) Minimum Trade Size: 3/4 inch.
    - 2) Colors: As indicated on Drawings.

**2.5 TYPE IMC RACEWAYS**

**A. Steel Electrical Intermediate Metal Conduit (IMC):**

1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standard: UL 1242 and UL Category Control Number DYBY.
    - 2) Exterior Coating: Zinc.
    - 3) Interior Coating: Zinc with organic top coating.
  - c. Options:
    - 1) Minimum Trade Size: 3/4 inch.
    - 2) Colors: As indicated on Drawings.

**2.6 TYPE LFMC RACEWAYS**

**A. Steel Liquidtight Flexible Metal Conduit (LFMC-S):**

1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.
    - 2) Material: Steel.
  - c. Options:
    - 1) Minimum Trade Size: 3/4 inch.
    - 2) Colors: As indicated on Drawings.

**B. Stainless Steel Liquidtight Flexible Metal Conduit (LFMC-SS):**

1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.

2) Material: Stainless steel.

c. Options:

1) Minimum Trade Size: 3/4 inch.

## 2.7 TYPE LFNC RACEWAYS

A. Layered (Type A) Liquidtight Flexible Nonmetallic Conduit (LFNC-A):

1. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

1) Reference Standard: UL 1660 and UL Category Control Number DXOQ, for Type A conduit with smooth seamless inner core and cover bonded together with one or more reinforcement layers between core and cover.

c. Options:

1) Minimum Trade Size: 3/4 inch.

B. Integral (Type B) Liquidtight Flexible Nonmetallic Conduit (LFNC-B):

1. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

1) Reference Standard: UL 1660 and UL Category Control Number DXOQ, for Type B conduit with smooth inner surface with integral reinforcement within conduit wall.

c. Options:

1) Minimum Trade Size: 3/4 inch.

2) Colors: As indicated on Drawings.

C. Corrugated (Type C) Liquidtight Flexible Nonmetallic Conduit (LFNC-C):

1. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

b. General Characteristics:

- 1) Reference Standard: UL 1660 and UL Category Control Number DXOQ, for Type C conduit with corrugated internal and external surfaces without integral reinforcement within conduit wall.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

**2.8 TYPE PVC RACEWAYS AND FITTINGS**

**A. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:**

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:

- 1) Reference Standards: UL 651 and UL Category Control Number DZYR.
- 2) Dimensional Specifications: Schedule 40.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

**B. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:**

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:

- 1) Reference Standards: UL 651 and UL Category Control Number DZYR.
- 2) Dimensional Specifications: Schedule 80.

c. Options:

- 1) Minimum Trade Size: 3/4 inch.

**2.9 FITTINGS FOR CONDUIT, TUBING, AND CABLE**

**A. Fittings for Type ERM, Type IMC, Type PVC, Type EPEC, and Type RTRC Raceways:**

1. Applicable Standards:



- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
  - 1) Reference Standards: UL 514B and UL Category Control Number DWTT.
  - 2) Material: Steel.
  - 3) Coupling Method: Compression coupling.

**B. Fittings for Type EMT Raceways:**

- 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. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standards: UL 514B and UL Category Control Number FKAV.
    - 2) Material: Steel.
    - 3) Coupling Method: Compression coupling.

**2.10 SURFACE METAL RACEWAYS AND FITTINGS**

**A. Surface Metal Raceways and Fittings with Metal Covers:**

- 1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standards: UL 5 and UL Category Control Number RJBT.
  - c. Options:
    - 1) Galvanized steel base with snap-on covers.
    - 2) Manufacturer's standard enamel finish.

**B. Surface Metal Raceways and Fittings with Nonmetallic Covers:**

- 1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

- b. General Characteristics:
  - 1) Reference Standards:
    - a) UL 5 and UL Category Control Number RJBT.
    - b) UL 94, V-0 requirements for self-extinguishing characteristics.
- c. Options:
  - 1) Galvanized steel base with snap-on covers.
  - 2) Provide texture and color selected by Architect from manufacturer's standard colors.
  - 3) Wiring Channels: Dual. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

## 2.11 SURFACE NONMETALLIC RACEWAYS

### A. Surface Nonmetallic Raceways and Fittings with Nonmetallic Covers:

- 1. Applicable Standards:
  - a. Options:
    - 1) Provide texture and color selected by Architect from manufacturer's standard colors.
    - 2) Wiring Channels: Dual. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

## 2.12 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

### A. Metallic Outlet Boxes:

- 1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
- 2. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
  - c. Options:

- 1) Sheet Metal Depth: Minimum 2 inch.
- 2) Cast-Metal Depth: Minimum 2.4 inch.
- 3) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
- 4) Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

**B. Metallic Device Boxes:**

1. Description: Box with provisions for mounting wiring device directly to box.
2. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
  - c. Options:
    - 1) Sheet Metal Depth: minimum 2 inch.
    - 2) Cast-Metal Depth: minimum 2.4 inch.
    - 3) Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.
    - 4) Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

**2.13 COVER PLATES FOR DEVICES BOXES**

**A. Metallic Cover Plates for Device Boxes:**

1. Applicable Standards:
  - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
  - b. General Characteristics:
    - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
    - 2) Wallplate-Securing Screws: Metal with head color to match wallplate finish.
  - c. Options:
    - 1) Wallplate Material in finished area: 0.032 inch thick Type 302/304 non-magnetic stainless steel with brushed finish.
    - 2) Material in non-finished area: Galvanized steel

**B. Nonmetallic Cover Plates for Device Boxes:**

**1. Applicable Standards:**

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
  - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
  - 2) Wallplate-Securing Screws: Metal with head color to match wallplate finish.
- c. Options:
  - 1) Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
  - 2) Color: White.

**2.14 HOODS FOR OUTLET BOXES**

**A. Extra-Duty, While-in-Use Hoods for Outlet Boxes:**

**1. Applicable Standards:**

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
  - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
  - 2) Marked "Extra-Duty" in accordance with UL 514D.
  - 3) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
  - 4) Mounts to box using fasteners different from wiring device.
- c. Options:
  - 1) Provides gray, polycarbonate weatherproof, "while-in-use" cover.

**PART 3 - EXECUTION****3.1 SELECTION OF RACEWAYS**

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Engineer for resolution of conflicting requirements.
- B. Outdoors:
  - 1. Exposed Conduit: IMC PVC-80.
  - 2. Concealed Conduit, Aboveground: IMC EMT PVC-80 PVC-40.
  - 3. Direct-Buried Conduit: PVC-80 PVC-40 EPEC-40.
  - 4. Concrete-Encased Conduit Not in Trench: PVC-80 PVC-40 PVC-A EPEC-40.
  - 5. Concrete-Encased Conduit in Trench: PVC-80 PVC-40 PVC-A PVC-EB EPEC-40.
  - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC LFNC-A.
- C. Indoors:
  - 1. Hazardous Classified Locations: IMC.
  - 2. Exposed and Subject to Physical Damage: IMC. Raceway locations include the following:
    - a. Loading docks.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
    - e. Locations less than 8 ft above finished floor.
  - 3. Exposed, Not Subject to Physical Damage: IMC PVC-80.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: IMC EMT PVC-80 PVC-40.
  - 5. Damp or Wet Locations: IMC.
  - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC FMC LFNC-A LFNC-B.
  - 7. Circuits Operating Above 60 Hz: . Provide nonmetallic sleeve where aluminum raceways pass through concrete.
- D. Stub-ups to Above Recessed Ceilings: Provide EMT, IMC, or ERM for raceways.
- E. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
  - 1. ERM and IMC: Provide threaded type fittings unless otherwise indicated.

**3.2 SELECTION OF BOXES AND ENCLOSURES**

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Engineer for resolution of conflicting requirements.
- B. Degree of Protection:
  - 1. Outdoors:
    - a. Type 3R unless otherwise indicated.
    - b. Locations Exposed to Hosedown: Type 4.
    - c. Locations Subject to Potential Flooding: Type 6P.
    - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
    - e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
    - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
  - 2. Indoors:
    - a. Type 1 unless otherwise indicated.
    - b. Damp or Dusty Locations: Type 12.
    - c. Locations Exposed to Hosedown: Type 4.
    - d. Locations Exposed to Corrosive Agents: Type 4X.
- C. Exposed Boxes Installed Less Than 6.5 ft. Above Floor:
  - 1. Provide cast-metal boxes.
  - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

**3.3 INSTALLATION OF RACEWAYS**

- A. Installation Standards:
  - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Engineer for resolution of conflicting requirements.
  - 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
  - 3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
  - 4. Comply with NECA NEIS 101 for installation of steel raceways.
  - 5. Comply with NECA NEIS 102 for installation of aluminum raceways.
  - 6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.

7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. 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.
9. Raceway Terminations at Locations Subject to Moisture or Vibration:
  - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

**B. General Requirements for Installation of Raceways:**

1. Complete raceway installation before starting conductor installation.
2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft. above finished floor.
3. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. 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 interior of raceways at the following points:
  - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - b. Where an underground service raceway enters a building or structure.
  - c. Conduit extending from interior to exterior of building.
  - d. Conduit extending into pressurized duct and equipment.
  - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - f. Where otherwise required by NFPA 70.
9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
10. Do not install conduits within 2 inch of the bottom side of a metal deck roof.

11. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
12. 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. Ream inside of conduit to remove burrs.
13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:

1. Types EMT-A, ERMCA, and FMC-A:
  - a. Do not install aluminum raceways or fittings in contact with concrete or earth.
2. Types ERMCA and IMC:
  - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
3. Types FMC, LFMC, and LFNC:
  - a. Comply with NEMA RV 3. Provide a maximum of 36 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
4. Types PVC and EPEC:
  - a. Do not install Type PVC or Type EPEC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
  - b. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Raceways Embedded in Slabs:

1. Run raceways larger than 1 inch trade size below concrete slab..
2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
3. Arrange raceways to ensure that each is surrounded by a minimum of 1 inch of concrete without voids.
4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
5. Change from ENT to PVC-80, PVC-40, IMC before rising above floor.



- E. Stub-ups to Above Recessed Ceilings:
1. Provide EMT, IMC, or ERM C for raceways.
  2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- F. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
1. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
  2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- G. Expansion-Joint Fittings:
1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft.. Install in runs of aboveground ERM C and EMT conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft..
  2. Install type and quantity of fittings that accommodate temperature change listed for 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.
    - e. .
  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 locations where conduits cross building or structure expansion joints.
  5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- H. Raceways Penetrating Rooms or Walls with Acoustical Requirements:
1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

### 3.4 INSTALLATION OF SURFACE RACEWAYS

- A. Install surface raceways only where indicated on Drawings.

- B. Install surface raceway with a minimum 2 inch radius control at bend points.
- C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

### 3.5 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. 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.
- C. 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, whether installed indoors or outdoors.
- D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- E. Locate boxes so that cover or plate will not span different building finishes.
- F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
- G. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
- H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- I. Set metal floor boxes level and flush with finished floor surface.
- J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
- M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
  - 1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.

2. Provide gaskets for wallplates and covers.

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "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 PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 260533

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**SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Round sleeves.
  2. Sleeve seal systems.

**PART 2 - PRODUCTS**

**2.1 SLEEVE SEAL SYSTEMS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.
  3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

**PART 3 - EXECUTION**

**3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    - b. 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 079200 "Joint Sealants."
  2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.

**B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:**

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

**C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.**

**D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.**

**E. Underground, Exterior-Wall and Floor Penetrations:**

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

### **3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS**

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.**
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.**

**END OF SECTION**

**SECTION 260573.16 - COORDINATION STUDIES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  - 1. Study results shall be used to determine coordination of series-rated devices.

**1.3 DEFINITIONS**

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. 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.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

- I. Single-Line Diagram: See "One-Line Diagram."

#### 1.4 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 may be in digital form.
  - a. Coordination-study input data, including completed computer program input data sheets.
  - b. Study and equipment evaluation reports.
3. Overcurrent protective device coordination 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 Engineer for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

#### 1.5 INFORMATIONAL SUBMITTALS

##### A. Qualification Data:

1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. The following are from the Coordination Study Report:
  - a. Final one-line diagram.
  - b. Final protective device coordination study.
  - c. Coordination study data files.
  - d. List of all protective device settings.
  - e. Time-current coordination curves.



- f. Power system data.
- 2. Provide electronic version of program files used to perform study for Owner's future use.

#### 1.7 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 System Analysis Software Qualifications:
  - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
  - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. 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.
- F. Field Adjusting Agency Qualifications:
  - 1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
  - 2. A member company of NETA.
  - 3. Acceptable to authorities having jurisdiction.

### 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. CGI CYME.
  - 2. EDSA Micro Corporation.
  - 3. ESA Inc.
  - 4. Operation Technology, Inc.
  - 5. Power Analytics, Corporation.
  - 6. SKM Systems Analysis, Inc.

- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1. Optional Features:
    - a. Arcing faults.
    - b. Simultaneous faults.
    - c. Explicit negative sequence.
    - d. Mutual coupling in zero sequence.

## 2.2 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 and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
  - 6. Any revisions to electrical equipment required by the study.
  - 7. Study Input Data: As described in "Power System Data" Article.
    - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- 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. Power utility's overcurrent protective device.
    - b. Medium-voltage equipment overcurrent relays.
    - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    - f. Cables and conductors damage curves.
    - g. Ground-fault protective devices.
    - h. Motor-starting characteristics and motor damage points.
    - i. Generator short-circuit decrement curve and generator damage point.
    - j. The largest feeder circuit breaker in each motor-control center and 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.

**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. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

**3.2 POWER SYSTEM DATA**

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
  - 1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Engineer'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 all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail 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 overcurrent protective devices specified in other Sections and 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. 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 reactors, provide manufacturer and model designation, voltage rating, and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. 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 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.
  - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
  - 3. .
- 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. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.

- K. 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.
- L. 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.
- M. 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.

### 3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
  - 1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
  - 2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
  - 3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

### 3.5 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and , and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

**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.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

**3.7 DEMONSTRATION**

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:
  - 1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
  - 2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
  - 3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION



**SECTION 260923 - LIGHTING CONTROL DEVICES****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Electronic time switches.
2. Outdoor photoelectric switches, solid state, flexible mounting.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Lighting contactors.
6. Emergency shunt relay.
7. Conductors and cables.

**1.2 ACTION SUBMITTALS****A. Shop Drawings:**

1. Show installation details for the following:
  - a. Occupancy sensors.
  - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

**PART 2 - PRODUCTS****2.1 ELECTRONIC TIME SWITCHES****A. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.**

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 20 A ballast load, 120/240 V(ac).
4. Astronomic Time: All channels.
5. Automatic daylight savings time changeover.

**2.2 INDOOR OCCUPANCY AND VACANCY SENSORS****A. General Requirements for Sensors:**

1. Ceiling-mounted, solid-state indoor occupancy sensors.
2. Dual technology.
3. Hardwired connection to switch.
4. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
5. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
6. Mounting:
  - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
  - b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
  - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
8. Bypass Switch: Override the "on" function in case of sensor failure.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

**B. Dual-Technology Type: Wall mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.**

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96 inch high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. when mounted 48 inch above finished floor.

**2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS**

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
  - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
  - 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
- B. Wall-Switch Sensor as indicated on drawings:
  - 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
  - 2. Sensing Technology: Dual technology - PIR and ultrasonic.
  - 3. Capable of controlling load in three-way application.
  - 4. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  - 5. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
  - 6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
  - 7. Color: White.
  - 8. Faceplate: Color matched to switch.

**2.4 CONDUCTORS AND CABLES**

- A. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF SENSORS

- 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 systems, and partition assemblies.
- B. 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 instructions.

### 3.3 INSTALLATION OF CONTACTORS

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.4 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.5 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

**3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested 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.
1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

**3.7 MAINTENANCE**

- A. Software and Firmware Service Agreement:
1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
  2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within Insert number years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
    - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
  3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260923

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**SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Lighting control relay panels.
2. Conductors and cables.

**1.2 DEFINITIONS**

- A. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

**1.3 ACTION SUBMITTALS****A. Shop Drawings: For each relay panel and related equipment.**

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and prepare panels for installation in accordance with NECA 407.

**PART 2 - PRODUCTS****2.1 SYSTEM DESCRIPTION**

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.
- B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- E. Comply with UL 916.

**2.2 LIGHTING CONTROL RELAY PANELS**

- A. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- B. Lighting Control Panel:
  - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
  - 2. A vertical barrier separating branch circuits from control wiring.
- C. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
  - 1. Timing Unit:
    - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
    - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
    - c. Four independent schedules, each having 24 time periods.
    - d. Schedule periods settable to the minute.
    - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
    - f. 10 special date periods.
  - 2. Sequencing Control with Override:



- a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
  - b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
  - c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
  - d. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence.
3. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation, including accurate time of day and date.

D. Relays:

1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac).
- E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.

## 2.3 CONDUCTORS AND CABLES

- A. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Twisted-Pair Data Cable: Category 6.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels in accordance with NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF WIRING

- A. Wiring Methods:
  - 1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters.
  - 2. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, accessible ceiling spaces, and gypsum board partitions where unenclosed wiring method may be used.
  - 3. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
  - 4. Conceal raceway and cables except in unfinished spaces.
  - 5. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
  - 6. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. 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.

### 3.3 INSTALLATION OF PANELS

- A. Install panels and accessories in accordance with NECA 407.
- B. Mount top of trim 90 inch above finished floor unless otherwise indicated.
- C. Mount panel cabinet plumb and rigid without distortion of box.
- D. Install filler plates in unused spaces.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 SYSTEM STARTUP

- A. Perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's instructions.
  - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.
  - 3. .

### 3.6 ADJUSTING

- A. 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.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943.23

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**SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 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.

**1.3 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. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

**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.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

## 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Terminal Connections: Bolted.
- D. Enclosure: .
  - 1. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  - 2. Wiring Compartment: Sized for conduit entry and wiring installation.
  - 3. Finish: Comply with NEMA 250.
    - a. Finish Color: Gray weather-resistant enamel.
- E. Enclosure: .
  - 1. Wiring Compartment: Sized for conduit entry and wiring installation.
  - 2. Finish: Comply with NEMA 250.
    - a. Finish Color: Gray weather-resistant enamel.
- F. Taps for Transformers 3 kVA and Smaller: None.
- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- I. Wall Brackets: Manufacturer's standard brackets.

**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 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
  - 2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. 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.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "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.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- 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 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "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 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.

### 3.5 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION



**SECTION 262416 - PANELBOARDS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

**1.3 DEFINITIONS**

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.
- F. VPR: Voltage protection rating.

**1.4 ACTION SUBMITTALS**

- A. 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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

#### 1.6 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 minus 22 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet.

### PART 2 - PRODUCTS

#### 2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: -mounted, dead-front cabinets.
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
3. Finishes:
  - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
4. .

E. 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.

F. 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. .

G. 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. .

## 2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards 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 from the device when subjected to the seismic forces specified."

B. 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. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- C. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: 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. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

**2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. 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.

4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. 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. Multipole units enclosed in a single housing with a single handle.
  - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or 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. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.
  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 panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
  - 3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- K. 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.
- L. 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.
- M. Install filler plates in unused spaces.

- N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- P. Mount spare fuse cabinet in accessible location.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard 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 260553 "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 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 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 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.

4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.5 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION



**SECTION 262726 - WIRING DEVICES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:

1. GFCI receptacles, 125 V, 20 A.
2. Toggle switches, 120/277 V, 20 A.
3. Occupancy sensors.
4. Wall-box dimmers.
5. Wall plates.
6. Poke-through assemblies.

**1.3 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.

**1.4 ACTION SUBMITTALS**

- A. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

**PART 2 - PRODUCTS****2.1 STANDARD-GRADE RECEPTACLES, 125 V, 20 A****A. Duplex Receptacles, 125 V, 20 A :**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Eaton (Arrow Hart).
  - b. Hubbell Incorporated; Wiring Device-Kellems.
  - c. Leviton Manufacturing Co., Inc.
  - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

**B. Weather-Resistant Duplex Receptacle, 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. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

**2.2 GFCI RECEPTACLES, 125 V, 20 A****A. Duplex GFCI Receptacles, 125 V, 20 A :**

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

**2.3 TOGGLE SWITCHES, 120/277 V, 20 A****A. Single-Pole Switches, 120/277 V, 20 A :**

1. Standards: Comply with UL 20 and FS W-S-896.

**B. Three-Way Switches, 120/277 V, 20 A :**

1. Comply with UL 20 and FS W-S-896.

## 2.4 OCCUPANCY SENSORS

### A. Wall Switch Sensor Light Switch, Dual Technology :

1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
2. Standards: Comply with UL 20.
3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
4. Adjustable time delay of 20 minutes.
5. Able to be locked to Automatic-On mode.
6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

## 2.5 DIMMERS

### A. Wall-Box Dimmers:

1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
2. Control: Continuously adjustable slider; with single-pole or three-way switching.
3. Standards: Comply with UL 1472.

## 2.6 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 Unfinished Spaces: Galvanized steel.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

### C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, extra-duty, rated "while-in-use" weather-resistant, die-cast aluminum with lockable cover.

### D. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

**2.7 POKE-THROUGH ASSEMBLIES**

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Standards: Comply with scrub water exclusion requirements in UL 514.
- C. Size: Selected to fit nominal 3-inch 4-inch cored holes in floor and matched to floor thickness.
- D. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

**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. Pigtail 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 right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. 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.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use self-adhesive label on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION

**SECTION 262813 - FUSES****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:

- 1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Motor-control centers.
  - c. Panelboards.
  - d. Switchboards.
  - e. Enclosed controllers.
  - f. Enclosed switches.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles. 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. Submit in PDF format.
  - 5. Coordination charts and tables and related data.
  - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

#### 1.4 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg For more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

### PART 2 - PRODUCTS

#### 2.1 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  - 1. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  - 2. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.
- D. 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. Service Entrance: Class T, fast acting.
2. Feeders: Class J, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Other Branch Circuits: Class J, time delay.
6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
7. 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.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Shunt trip switches.
  - 4. Molded-case circuit breakers (MCCBs).

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For enclosed switches and circuit breakers.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

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.
  - 2. Altitude: Not exceeding 6600 feet.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Enclosed switches and circuit breakers 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 from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

**2.2 GENERAL REQUIREMENTS**

- A. Source Limitations: Obtain enclosed switches and circuit breakers, 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 switches and circuit breakers, including clearances between enclosures, 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 an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

**2.3 FUSIBLE SWITCHES**

- A. Type HD, Heavy Duty:
  - 1. throw.
  - 2. Three pole.
  - 3. -V ac.
  - 4. 1200 A and smaller.
  - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
  - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Lugs: Mechanical type, suitable for number, size, and conductor material.

**2.4 NONFUSIBLE SWITCHES**

**A. Accessories:**

1. Lugs: Mechanical type, suitable for number, size, and conductor material.

**2.5 SHUNT TRIP SWITCHES**

- A.** General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- B.** Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: -V ac, A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C.** Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- D.** Accessories:
1. Oiltight key switch for key-to-test function.
  2. Oiltight red ON pilot light.
  3. Isolated neutral lug; 100 percent rating.
  4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  5. Form C alarm contacts that change state when switch is tripped.
  6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
  7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
  8. Lugs: Mechanical type, suitable for number, size, and conductor material.

**2.6 MOLDED-CASE CIRCUIT BREAKERS**

- A.** Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B.** Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. \_\_\_\_\_ Amps Available. Identical Replacement Component Required."
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 140 deg F rated wire on 125-A circuit breakers and below.
- F. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers 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 PREPARATION

- A. 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.

**3.3 INSTALLATION**

- A. Coordinate layout and installation of switches, circuit breakers, 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 switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

**3.4 IDENTIFICATION**

- A. Comply with requirements in Section 260553 "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.

**3.5 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 260573.16 "Coordination Studies."

END OF SECTION 262816

## **ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

LXT Eastside Development

## **SECTION 262816**

Project #47732472  
Permit Set 09/29/23

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SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Enclosed full-voltage magnetic motor controllers.
  - 2. Combination full-voltage magnetic motor controllers.
  - 3. Combination reduced-voltage magnetic motor controllers.
  - 4. Identification.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For each type of magnetic controller.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.

3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

#### 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. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.
  3. The effect of solar radiation is not significant.

### 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.
- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified."
  2. Component Importance Factor: 1.0.

**2.2 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS**

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less for motors up to 10 hp
- 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. Eaton.
  - 2. General Electric Company.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Control Power:
  - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. Spare CPT Capacity as Indicated on Drawings: 100 VA.

**2.3 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER**

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- C. Configuration: Nonreversing.
- D. Control Power:
  - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. Spare CPT Capacity: 100 VA.
- E. Overload Relays:
  - 1. Solid-State Overload Relay:

- a. Switch or dial selectable for motor-running overload protection.
  - b. Sensors in each phase.
  - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- F. 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.

## 2.4 COMBINATION REDUCED-VOLTAGE MOTOR CONTROLLERS

- A. Description: Factory-assembled, combination reduced-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, and SCPD and OCPD, in a single enclosure.
- B. Configuration:
  - 1. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
- C. Control Power: -V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - 1. Spare CPT Capacity: 100 VA.
- D. Overload Relays:
  - 1. Thermal Overload Relays: Bimetallic type.
    - a. Inverse-time-current characteristic.
    - b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - c. Ambient compensated.
    - d. Automatic resetting.
  - 2. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

## 2.5 MULTISPEED MAGNETIC CONTROLLERS

- A. Standard: Comply with NEMA ICS 2, general purpose, Class A.

1. Configuration: Nonreversing, multispeed.
2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
  - a. Operating Voltage: Manufacturer's standard, unless indicated.
3. Power Contacts: Totally enclosed, double break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
4. Control Power: 24 -V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. Spare CPT Capacity: 100 VA.

## 2.6 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

## 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 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- D. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

- F. 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.
- G. 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.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 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.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION

**SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Section Includes:**

1. Type 2 surge protective devices.
2. Enclosures.

**1.2 DEFINITIONS**

- A.  $I_n$ : Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.
- G. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- H. Type 3 SPDs: Point of utilization SPDs.
- I. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- J. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.
- K. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

## PART 2 - PRODUCTS

### 2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Source Limitations: Obtain devices from single source from single manufacturer.
- B. General Characteristics:
  - 1. Service Entrance Location: Peak Surge Current Rating: Minimum single pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
  - 2. Branch Panel Location: Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA/ Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
  - 3. Ten distinct protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
    - a. Line to Neutral: 1200 V for 480Y/277 V 700 V for 208Y/120 V.
    - b. Line to Ground: 1200 V for 480Y/277 V 700 V for 208Y/120 V.
    - c. Neutral to Ground: .
    - d. Line to Line: 2000 V for 480Y/277 V 1200 V for 208Y/120 V.
  - 4. Six distinct protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
    - a. Line to Neutral: 700 V.
    - b. Line to Ground: 700 V.
    - c. Neutral to Ground: 700 V.
    - d. Line to Line: 1200 V.
  - 5. SCCR: Equal or exceed 100 kA.
  - 6. I<sub>n</sub> Rating: 20 kA.

### 2.2 ENCLOSURES

- A. Indoor Enclosures: Type 1.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.



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- B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  - 1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
  - 2. Do not exceed manufacturer's recommended lead length.
  - 3. Do not bond neutral and ground.
- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

### **3.2 STARTUP SERVICE**

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

### **3.3 DEMONSTRATION**

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

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**SECTION 265119 - LED INTERIOR LIGHTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Interior solid state luminaries that use LED technology.
  - 2. Materials.

**1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.4 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 and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified in the Light Fixture Schedule on the plans or an approved equal.
- B. Seismic Performance:
  - 1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  - 2. Luminaires and lamps shall be labeled vibration and shock resistant.
  - 3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."
- C. Ambient Temperature: 41 to 104 deg F.
  - 1. Relative Humidity: Zero to 95 percent.
- D. Altitude: Sea level to 1000 feet.

**2.2 LUMINAIRE 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. Luminaries shall be provided with internal drivers unless noted otherwise.
- C. Lamp shall be rated for 50,000 hours minimum and have a CRI of minimum 80.
- D. Fixture Whips: Minimum #14 cu with ground wire in 1/2" C.
- E. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers and other components from falling accidentally during relamping and when secured in operating position. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated.
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
  - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is scheduled.
  - b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
  - a. "USE ONLY" and include specific lamp type.
  - b. Lamp diameter, shape, size, wattage, and coating.
  - c. CCT and CRI.

H. Recessed luminaires shall comply with NEMA LE 4.

I. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

J. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

K. California Title 24 compliant.

## 2.3 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.

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.

## 2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
1. Sized and rated for luminaire weight.
  2. Able to maintain luminaire position after cleaning and relamping.

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.
- E. Flush-Mounted Luminaires:
1. Secured to outlet box.
  2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
1. Attached to structural members in walls.
  2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
1. Ceiling Mount:
    - a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
    - b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
    - c. Hook mount.
  2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
  2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
  3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

**3.4 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

**3.5 STARTUP SERVICE**

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

**3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION



**SECTION 265613 - LIGHTING POLES AND STANDARDS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Poles and accessories for support of luminaires.

**1.3 DEFINITIONS**

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. 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.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below finished grade.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

**PART 2 - PRODUCTS****2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.
- B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.0.
  - 3. .
- C. Structural Characteristics: Comply with AASHTO LTS-6-M.
- D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- E. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- F. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
  - 1. Basic wind speed for calculating wind load for poles exceeding 50 feet in height is 100 mph.
    - a. Wind Importance Factor: 1.0.
    - b. Minimum Design Life: 50 years.
    - c. Velocity Conversion Factor: 1.0.
  - 2. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
    - a. Wind Importance Factor: 1.0.
    - b. Minimum Design Life: 25 years.
    - c. Velocity Conversion Factor: 1.0.
- H. 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.
- I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

**2.2 STEEL POLES**

- 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 LitePole.
  2. Bridgewell Resources.
  3. Cooper Lighting, an Eaton business.
  4. E-conolight.
  5. EGS/Appleton Electric.
  6. H.E. Williams.
  7. Hapco.
  8. Hubbell Incorporated.
  9. KIM Lighting.
  10. Lithonia Lighting; Acuity Brands Lighting, Inc.
  11. LSI Industries.
  12. Millerbernd Manufacturing Company.
  13. NAFCO International.
  14. Ruud Lighting Direct.
  15. Union Metal Corporation.
- B. Poles: Comply with ASTM A 500/A 500M, 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.
1. Shape: Round, tapered Round, straight Square, tapered Square, straight.
  2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Steel Mast Arms: Single-arm Truss Davit type, continuously welded to pole attachment plate. Material and finish same as plate.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.
1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless -steel bolts.
  2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- 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-dip galvanized after fabrication unless otherwise indicated.

- G. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.
- H. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- I. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A 123/A 123M.
- J. 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.
    - a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: . As indicated on plans.

## 2.3 ALUMINUM POLES

- A. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" 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, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; 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.

## 2.4 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Two nuts provided per anchor bolt .

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Two washer(s) provided per anchor bolt.

2.5 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 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 areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. 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.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; 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 033000 "Cast-in-Place Concrete."
- B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

- A. Alignment: Align poles as indicated.

- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
  - 1. Fire Hydrants and Water Piping: 60 inches.
  - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
  - 3. Trees: 15 feet from tree trunk.
  - 4. .
- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
  - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - 3. Install base covers unless otherwise indicated.
  - 4. 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.
- D. Poles and Pole Foundations Set in Concrete-Paved Areas: 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.
- E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

### 3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 260533 "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.

### 3.5 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole unless otherwise indicated.

**3.6 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 265613

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**SECTION 265619 - EXTERIOR LIGHTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.3 ACTION SUBMITTALS**

- A. Shop Drawings: For nonstandard or custom luminaires.
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of luminaire 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.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

**1.5 FIELD CONDITIONS**

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

### 2.2 FINISHES

- A. Variations in Finishes: 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. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: 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, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; 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 called for in Light Fixture Schedule.

**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 electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 TEMPORARY LIGHTING**

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

**3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 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.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls or.

- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### 3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

### 3.5 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 260533 "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.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

**3.8 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

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SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding rods.
  - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

**PART 2 - PRODUCTS**

**2.1 CONDUCTORS**

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- C. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
  - 2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

**2.2 GROUNDING BUSBARS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - 1. Chatsworth Products, Inc.
  - 2. Harger Lightning & Grounding.
  - 3. Panduit Corp.
- C. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
  - 1. Predrilling shall be with holes for use with lugs specified in this Section.
  - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.



**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

**3.3 APPLICATION**

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. 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.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
  - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
  2. Pretwist the conductor.
  3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- G. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- H. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- J. Access Floors: Bond all metal parts of access floors to the TGB.
- K. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
  2. Bond the TGB of the equipment room to the reference grid at two or more locations.
  3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- L. Towers and Antennas:
1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
  2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.

3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.
4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
5. Special Requirements for Roof-Mounted Towers:
  - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
  - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
  - c. Connect roof ring to the perimeter conductors of the lightning protection system.
6. Waveguides and Coaxial Cable:
  - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
  - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

**3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

END OF SECTION

SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Firestopping relating to communications work.
3. Equipment bases and supports.

B. Related Sections:

1. Section 260529 - Hangers and Supports for Electrical Systems.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

### 1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

### 1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: Comply with requirements of Section 078400.
- B. Firestopping Materials: UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
- C. Firestopping Materials: UL 1479, to achieve fire ratings of adjacent construction
- D. Firestop interruptions to fire rated assemblies, materials, and components.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping Materials: Comply with requirements of Section 078400.
- B. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- C. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

### 1.6 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
  1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
  2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
    - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
  2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- 1.8 ENVIRONMENTAL REQUIREMENTS
- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

## PART 2 - PRODUCTS

### 2.1 SLEEVES

- A. **Sleeves for** Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

**2.2 FIRESTOPPING**

- A. Firestopping Materials: Comply with requirements of Section 078400.
- B. Manufacturers:
  - 1.
  - 2.
  - 3.
  - 4.
  - 5.
- C. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
  - 1. Foam Firestopping Compounds: Single component foam compound.
- D. Color: Black.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

**3.2 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- D. Do not drill or cut structural members.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.



**3.3 INSTALLATION - HANGERS AND SUPPORTS**

**A. Anchors and Fasteners:**

1. Concrete Structural Elements: Provide , expansion anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Solid Masonry Walls: Provide expansion anchors and preset inserts.
5. Sheet Metal: Provide sheet metal screws.
6. Wood Elements: Provide wood screws.

**B. Inserts:**

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

**C. Install conduit and raceway support and spacing in accordance with NEC.**

**D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.**

**E. Install multiple conduit runs on common hangers.**

**F. Supports:**

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

**3.4 INSTALLATION - FIRESTOPPING**

**A. Firestopping Materials: Comply with requirements of Section 078400.**

**B. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.**

**C. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.**

- D. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating .
- E. Fire Rated Surface:
  - 1. Seal opening at wall, ceiling, and roof as follows:
    - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
    - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
    - c. Pack void with backing material.
    - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
  - 2. Where cable tray, conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

### 3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 033000.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

### 3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.
- B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION 280528.29

## **HANGERS AND SUPPORTS FOR COMMUNICATIONS**

LXT Eastside Development

## **SECTION 270529**

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SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cable tray.
- B. Related Sections:
  - 1. Section 270526 - Grounding and Bonding for Communications Systems.

1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. National Electrical Manufacturers Association:
  - 1. NEMA FG 1 - Nonmetallic Cable Tray Systems.
  - 2. NEMA VE 1 - Metal Cable Tray Systems.
  - 3. NEMA VE 2 - Metal Cable Tray Installation Guidelines.

PART 2 - PRODUCTS

2.1 METAL LADDER-TYPE CABLE TRAY

- A. Manufacturers:
  - 1. Allied Tube & Conduit; a part of Atkore International.
  - 2. B-line, an Eaton business.
  - 3. Calvert Company (The).
  - 4. Chalfant Manufacturing Company.
  - 5. Legrand US.
  - 6. MP Husky USA Cable Tray & Cable Bus.
  - 7. Niedax Inc.
  - 8. Square D; by Schneider Electric.
- B. Product Description: NEMA VE 1, Class 20C ladder type tray.

## CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

LXT Eastside Development

## SECTION 270536

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- C. Material: Steel.
- D. Finish: Galvanized to ASTM A123/A123M; galvanize after fabrication.
- E. Inside Width: As indicated on Drawings.
- F. Inside Depth: As indicated on Drawings.
- G. Straight Section Rung Spacing: 12 inches on center.
- H. Inside Radius of Fittings: As indicated on Drawings.
- I. Furnish manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install metal cable tray in accordance with NEMA VE 2.
- B. Install fiberglass cable tray in accordance with NEMA FG 1.
- C. Install expansion connectors where recommended by manufacturer.
- D. Install firestopping in accordance with Section 078400 to sustain ratings when passing cable tray through fire-rated elements.
- E. Ground and bond metal cable tray in accordance with Section 270526.
  - 1. Provide continuity between tray components.
  - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
  - 3. Install 2 AWG bare copper equipment grounding conductor through entire length of tray; bond to each component.
  - 4. Make connections to tray using mechanical, compression or exothermic connectors.

END OF SECTION

## SECTION 271343 - COMMUNICATIONS SERVICES CABLING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes arrangement with Telecommunications Utility Company for telecommunication service; and backboards, termination devices, outlets, and premises wiring.

**B. Related Sections:**

1. Section 262726 - Wiring Devices: Wall plates.
2. Section 270526 - Grounding and Bonding for Communications Systems.
3. Section 270536 - Cable Trays for Communications Systems.

## 1.2 REFERENCES

- A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- B. National Fire Protection Association:

1. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

- C. Telecommunications Industry Association/Electronic Industries Alliance:

1. TIA/EIA 568 - Commercial Building Telecommunications Cabling Standard.
2. TIA/EIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.

- D. Underwriters Laboratories, Inc.:

1. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-Handling Spaces.

## 1.3 SYSTEM DESCRIPTION

- A. Service entrance from Telecommunications Utility Company.
- B. Service Entrance Pathway: Empty ducts and raceway from point of Telephone Utility connection at manhole to building service terminal backboard.

- C. Backbone Pathway: Conform to TIA/EIA 569 using as indicated on Drawings.
- D. Horizontal Pathway: Conform to TIA/EIA 569, using raceway as indicated on Drawings.
- E. Entrance Wiring: By Telephone Utility Company.
- F. Backbone Wiring: Complete from entrance equipment to each telecommunications closet using [shielded] [optical fiber] backbone cables.
- G. Horizontal Wiring: Complete from telecommunications closet to each outlet using shielded horizontal cables.

#### 1.4 SUBMITTALS

- A. Product Data: Submit catalog data for each termination device, cable, and outlet device.

#### 1.5 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.
- B. Provide combustible electrical equipment exposed within plenums with peak rate of heat release not greater than 100 kW, peak optical density not greater than 0.5, and average optical density not greater than 0.15 when tested in accordance with UL 2043.

#### 1.6 COORDINATION

- A. Coordinate with utility company, relocation of overhead or underground lines interfering with construction. Where power lines are to be relocated, bill utility costs directly to Owner.
- B. Contact utility company regarding charges related to service installation. Include utility charges in this contract.
- C. Utility charges for service installation paid by Owner and are not part of this contract.

### PART 2 - PRODUCTS

#### 2.1 TELEPHONE TERMINATION CABINETS

- A. Manufacturers:
  - 1. B-line, an Eaton business.
  - 2. Erickson Electrical Equipment Company.



3. Hoffman; a brand of Pentair Equipment Protection.
4. Hubbell Premise Wiring.

B. Cabinet Fronts: Steel, surface type screw cover front, concealed hinge, double doors, and flush lock .

C. Finish: Gray baked enamel.

## 2.2 PATCH PANEL

A. Manufacturers:

1. Hyperline Systems Inc.
2. Siemon.

B. Product Description: TIA/EIA 568, rack-mounted assembly of terminals and accessory patch cords, with adequate capacity for active and spare circuits.

## 2.3 TELEPHONE OUTLET JACKS

A. Manufacturers:

1. Eaton (Arrow Hart).
2. Leviton Manufacturing Co., Inc.
3. Philips Lighting Company.

B. Product Description: Conform to TIA/EIA 568 requirements for cable connectors for specific cable types.

## 2.4 OPTICAL FIBER BACKBONE CABLE

A. Manufacturers:

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. CommScope, Inc.
3. General Cable; General Cable Corporation.
4. Mohawk; a division of Belden Networking, Inc.
5. Superior Essex Inc.

B. Product Description: TIA/EIA 568, 62.5/125 um optical fiber plenum rated cable.

## 2.5 SHIELDED HORIZONTAL CABLE

A. Manufacturers:

1. Hyperline Systems Inc.

2. Mohawk; a division of Belden Networking, Inc.
  3. Siemon.
- B. Product Description: TIA/EIA 568, 150-ohm shielded, twisted-pair plenum rated cable with 2 pairs, 22 AWG copper conductor.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install pathways in accordance with TIA/EIA 569.
- B. Install wire and cable in accordance with TIA/EIA 568.
- C. Install termination backboards plumb, and attach securely to building wall .
- D. Install pull wire in each empty telephone conduit over 10 feet in length or containing bends.
- E. Ground and bond pathways, cable shields, and equipment in accordance with Section 270526.

#### 3.2 FIELD QUALITY CONTROL

- A. Inspect and test optical fiber cables in accordance with NETA ATS, except Section 4. Perform inspections and tests listed in NETA ATS, Section 7.25.
- B. Inspect and test copper cables and terminations in accordance with TIA/EIA 568.

END OF SECTION

**SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY****A. Section Includes:**

1. Addressable fire-alarm system.
2. Fire-alarm control unit (FACU).
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Carbon monoxide detectors.
7. Heat detectors.
8. Fire-alarm notification appliances.
9. Fire-alarm remote annunciators.
10. Fire-alarm addressable interface devices.
11. Digital alarm communicator transmitters (DACTs).

**B. Related Requirements:**

1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.

**1.3 DEFINITIONS**

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).

- F. NICET: National Institute for Certification in Engineering Technologies.
- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
  - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
  - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

#### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: For fire-alarm system.
  - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
  - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  - 4. Annunciator panel details as required by authorities having jurisdiction.
  - 5. Detail assembly and support requirements.
  - 6. Include voltage drop calculations for notification-appliance circuits.
  - 7. Include battery-size calculations.
  - 8. Include input/output matrix.
  - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
  - 10. Include performance parameters and installation details for each detector.
  - 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
  - 13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    - c. Locate detectors in accordance with manufacturer's written instructions.
    - d. Show air-sampling detector pipe routing.

14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

B. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
4. Keys and Tools: One extra set for access to locked or tamperproofed components.
5. Audible and Visual Notification Appliances: One of each type installed.
6. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

#### 1.6 FIELD CONDITIONS

A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE/SEI 7 for installed elevation above or below grade.

1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads and unit must be fully operational after seismic event."

**PART 2 - PRODUCTS****2.1 ADDRESSABLE FIRE-ALARM SYSTEM****A. Description:**

1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice-and-strobe notification for evacuation.

**B. Performance Criteria:**

1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:

- 1) Manual stations.
- 2) Heat detectors.
- 3) Flame detectors.
- 4) Smoke detectors.
- 5) Duct smoke detectors.
- 6) Carbon monoxide detectors.
- 7) Automatic sprinkler system water flow.
- 8) .

- c. Fire-alarm signal must initiate the following actions:

- 1) Continuously operate alarm notification appliances, including voice evacuation notices.
- 2) Identify alarm and specific initiating device at FACU and remote annunciators.
- 3) Transmit alarm signal to remote alarm receiving station.
- 4) Unlock electric door locks in designated egress paths.
- 5) Release fire and smoke doors held open by magnetic door holders.
- 6) Activate voice/alarm communication system.
- 7) Switch HVAC equipment controls to fire-alarm mode.
- 8) Close smoke dampers in air ducts of designated air-conditioning duct systems.
- 9) Recall elevators to primary or alternate recall floors.
- 10) Activate elevator power shunt trip.

- 11) Activate emergency shutoffs for gas and fuel supplies.
  - 12) Record events in system memory.
  - 13) Record events by system printer.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
- 1) Valve supervisory switch.
  - 2) High- or low-air-pressure switch of dry-pipe or preaction sprinkler system.
  - 3) Alert and Action signals of air-sampling detector system.
  - 4) Elevator shunt-trip supervision.
  - 5) Independent fire-detection and -suppression systems.
  - 6) Zones or individual devices have been disabled.
  - 7) FACU has lost communication with network.
- e. System trouble signal initiation must 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 communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  - 4) Loss of primary power at FACU.
  - 5) Ground or single break in internal circuits of FACU.
  - 6) Abnormal ac voltage at FACU.
  - 7) Break in standby battery circuitry.
  - 8) Failure of battery charging.
  - 9) Abnormal position of switch at FACU or annunciator.
  - 10) Voice signal amplifier failure.
  - 11) Hose cabinet door open.
- f. System Supervisory Signal Actions:
- 1) Initiate notification appliances.
  - 2) Identify specific device initiating event at FACU and remote annunciators.
  - 3) Record event on system printer.
  - 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
  - 5) Transmit system status to building management system.
  - 6) Display system status on graphic annunciator.
- g. Network Communications:
- 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
  - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.

- 3) Provide integration gateway using BACnet for connection to building automation system.
- h. System Printer:
  - 1) Printer must be listed and labeled as integral part of fire-alarm system.
- i. Device Guards:
  - 1) Description: Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.
    - a) Factory fabricated and furnished by device manufacturer.
    - b) Finish: Paint of color to match protected device.
- j. Document Storage Box:
  - 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
  - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
  - 3) Color: Red powder-coat epoxy finish.
  - 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
  - 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

## 2.2 FIRE-ALARM CONTROL UNIT (FACU)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Honeywell International (Fire-Lite Alarms).
  - 2. Honeywell International (Honeywell Gamewell-FCI).
  - 3. Honeywell International (Notifier).
  - 4. Honeywell International (Silent Knight).
  - 5. United Technologies Corporation (UTC Climate, Controls & Security - Edwards).
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
  - 1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
  - 2. General Characteristics:



- a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
- b. Include real-time clock for time annotation of events on event recorder and printer.
- c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
- d. FACU must be listed for connection to central-station signaling system service.
- e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
- f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
- g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
  - 1) Annunciator and Display: LCD, 80 characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
  - 1) Annunciator and Display: LCD, two three Insert number line(s) of 40 80 Insert number characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  - 1) Pathway Class Designations: NFPA 72, Class B.
  - 2) Pathway Survivability: Level 0 .
  - 3) Install no more than 50 addressable devices on each signaling-line circuit.
  - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- j. Serial Interfaces:
  - 1) One dedicated RS 485 port for remote station operation using point ID DACT.

- 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - 3) One USB port for PC configuration.
  - 4) One RS 232 port for air-aspirating smoke detector connection.
  - 5) One RS 232 port for voice evacuation interface.
- k. Smoke-Alarm Verification:
- 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
  - 2) Activate approved "alarm-verification" sequence at FACU and detector.
  - 3) Record events by system printer.
  - 4) Sound general alarm if alarm is verified.
  - 5) Cancel FACU indication and system reset if alarm is not verified.
- l. Notification-Appliance Circuit:
- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
  - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
  - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- m. Elevator Recall: Initiate by one of the following alarm-initiating devices:
- 1) Elevator lobby detectors except lobby detector on designated floor.
  - 2) Smoke detectors in elevator machine room.
- n. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- o. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
- 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.
- p. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.
- q. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- r. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as special module that is part of FACU.

- s. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
  - 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
  - 2) Programmable tone and message sequence selection.
  - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
  - 4) 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 FACU.
- t. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
- u. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- v. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
- w. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory and DACT and must be powered by 24 V(dc) source.
- x. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- y. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- z. Batteries: Sealed, valve-regulated, recombinant lead acid.

D. Accessories:

- 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
- 2. Preaction System Functionality:
  - a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

## 2.3 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must 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 alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
  2. Station Reset: Key- or wrench-operated switch.
  3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
  4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm.
  5. Able to perform at up to 90 percent relative humidity at 90 deg F.

## 2.4 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
1. Performance Criteria:
    - a. Regulatory Requirements:
      - 1) NFPA 72.
      - 2) UL 268.
    - b. General Characteristics:
      - 1) Detectors must be four -wire type.
      - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
      - 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
      - 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
      - 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
      - 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
      - 7) Operator at FACU, having designated access level, must 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.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
  - 9) Color: White.
  - 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
  - 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
  - 12) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
  - 13) Multiple levels of detection sensitivity for each sensor.
  - 14) Sensitivity levels based on time of day.

**B. Ionization Smoke Detectors:**

**1. Performance Criteria:**

**a. Regulatory Requirements:**

- 1) NFPA 72.
- 2) UL 268.

**b. General Characteristics:**

- 1) Detectors must be four -wire type.
- 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must 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.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 12) Fixed-temperature sensing characteristic of combination smoke- and heat-detection units must be independent of rate-of-rise sensing and must be settable at FACU to operate at 135 or 155 deg F.
- 13) Multiple levels of detection sensitivity for each sensor.
- 14) Sensitivity levels based on time of day.

## 2.5 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.
- b. UL 268A.

2. General Characteristics:

- a. Detectors must be four -wire type.
- b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- f. Operator at FACU, having designated access level, must 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.).
- g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
- h. Each sensor must have multiple levels of detection sensitivity.
- i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
- j. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.6 CARBON MONOXIDE DETECTORS

A. Description: Carbon monoxide detector listed for connection to fire-alarm system.

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72
- b. NFPA 720.
- c. UL 2075.

2. General Characteristics:

- a. Mounting: Adapter plate for outlet box mounting.
- b. Testable by introducing test carbon monoxide into sensing cell.
- c. Detector must provide alarm contacts and trouble contacts.
- d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
- e. Locate, mount, and wire in accordance with manufacturer's written instructions.
- f. Provide means for addressable connection to fire-alarm system.
- g. Test button simulates alarm condition.

## 2.7 HEAT DETECTORS

A. Combination-Type Heat Detectors:

1. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 521.

b. General Characteristics:

- 1) Temperature sensors must test for and communicate sensitivity range of device.
- 2) Actuated by fixed temperature of 135 deg F or rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
- 3) Mounting: Twist-lock base interchangeable with smoke-detector bases.
- 4) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 5) Detector must have functional humidity range of 10 to 90 percent relative humidity.
  - a) Color: White.

**B. Fixed-Temperature-Type Heat Detectors:**

**1. Performance Criteria:**

**a. Regulatory Requirements:**

- 1) NFPA 72.
- 2) UL 521.

**b. General Characteristics:**

- 1) Actuated by temperature that exceeds fixed temperature of 190 deg F.
- 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
- 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 4) Detector must have functional humidity range of 10 to 90 percent.
- 5) Color: White.

**2.8 FIRE-ALARM NOTIFICATION APPLIANCES**

**A. Fire-Alarm Voice/Tone Notification Appliances:**

1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Performance Criteria:

**a. Regulatory Requirements:**

- 1) NFPA 72.
- 2) UL 1480.

**b. General Characteristics:**

- 1) Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
- 2) High-Range Units: Rated 2 to 15 W.



- 3) Low-Range Units: Rated 1 to 2 W.
- 4) Mounting: surface mounted and bidirectional.
- 5) Matching Transformers: Tap range matched to acoustical environment of speaker location.
- 6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

**B. Fire-Alarm Visible Notification Appliances:**

**1. Performance Criteria:**

**a. Regulatory Requirements:**

- 1) NFPA 72.
- 2) UL 1971.

**b. General Characteristics:**

- 1) Rated Light Output:
  - a) 15/30/75/110 cd, selectable in field.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, red white.

**2.9 FIRE-ALARM REMOTE ANNUNCIATORS**

**A. Performance Criteria:**

**1. Regulatory Requirements:**

- a. NFPA 72.

**2. General Characteristics:**

- a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
  - 1) Mounting: Surface cabinet, NEMA 250, Type 1.

- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

### A. Performance Criteria:

#### 1. Regulatory Requirements:

- a. NFPA 72.

#### 2. General Characteristics:

- a. Include address-setting means on module.
- b. Store internal identifying code for control panel use to identify module type.
- c. Listed for controlling HVAC fan motor controllers.
- d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
- e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
  - 1) Allow control panel to switch relay contacts on command.
  - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
- f. Control Module:
  - 1) Operate notification devices.
  - 2) Operate solenoids for use in sprinkler service.
  - 3) .

## 2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

### A. Performance Criteria:

#### 1. Regulatory Requirements:

- a. NFPA 72.

#### 2. General Characteristics:

- a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.

- b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture one telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
- c. Local functions and display at DACT must 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 central station or FACU.
- d. Digital data transmission must include the following:
  - 1) Address of alarm-initiating device.
  - 2) Address of supervisory signal.
  - 3) Address of trouble-initiating device.
  - 4) Loss of ac supply.
  - 5) Loss of power.
  - 6) Low battery.
  - 7) Abnormal test signal.
  - 8) Communication bus failure.
  - 9) .
- e. Secondary Power: Integral rechargeable battery and automatic charger.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for 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 and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
  - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.
- C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

### 3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before other trades have completed cleanup must be replaced.
  - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Equipment Floor Mounting: Install FACU on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install seismic bracing. Comply with requirements in Section 270548.16 "Seismic Controls for Communications Systems."
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around 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 supported equipment.
- C. Equipment Floor and Wall Mounting: Install FACU on finished floor.
  - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

- D. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
  - 1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- E. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
  - 2. Mount manual fire-alarm box on background of contrasting color.
  - 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.
- F. Smoke- and Heat-Detector Spacing:
  - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  - 3. Smooth ceiling spacing must not exceed 30 ft..
  - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
  - 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
  - 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- G. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- H. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
  - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- I. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- J. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

- M. Device Location-Indicating Lights: Locate in public space near device they monitor.
- N. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists wind load of 100 mph with gust factor of 1.3 without damage.

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "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 must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
  - 2. Nameplate must be laminated acrylic or melamine plastic signs with 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 in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

### 3.6 PATHWAYS

- A. Pathways must be installed in EMT.
- B. All EMT must be painted red enamel.

**3.7 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 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated HVAC duct systems.
  - 4. Magnetically held-open doors.
  - 5. Electronically locked doors and access gates.
  - 6. Alarm-initiating connection to elevator recall system and components.
  - 7. Supervisory connections at valve supervisory switches.
  - 8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 9. Supervisory connections at elevator shunt-trip breaker.
  - 10. Data communication circuits for connection to building management system.
  - 11. Supervisory connections at fire-extinguisher locations.

**3.8 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

**3.9 GROUNDING**

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

**3.10 FIELD QUALITY CONTROL**

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:

1. Owner will engage qualified testing agency to administer and perform tests and inspections.
  2. Engage qualified testing agency to administer and perform tests and inspections.
  3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
  4. Administer and perform tests and inspections.
- C. Tests and Inspections:
1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
  2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
  4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
  5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
  6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify 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.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.



**3.11 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

**3.12 MAINTENANCE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
  - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

**3.13 SOFTWARE SERVICE AGREEMENT**

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

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