

# Project Manual

Bid Package 02

Volume I

Divisions 00, Through 14, 31 through 33

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## Cherokee Nation WILMA P. MANKILLER HEALTH CENTER EXPANSION

Stilwell, Oklahoma

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December 06, 2019



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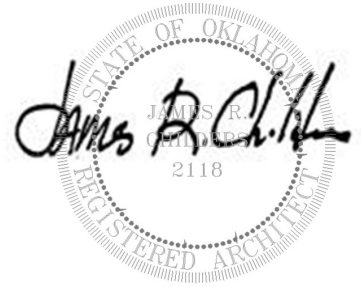
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12.06.2019

## ISSUES

<b>Bid Package 01</b>	<b>Demolition/Foundation/Steel</b>	<b>Nov. 01, 2019</b>
<b>Bid Package 02</b>	<b>Construction Documents</b>	<b>Dec. 06, 2019</b>



### NOTE FOR REVISED SPECIFICATION SECTIONS

1. DELETED INFORMATION IS INDICATED BY A STRIKETHROUGH (IE, ~~THIS IS DELETED~~).
2. NEW INFORMATION IS INDICATED BY A DOUBLE UNDERLINE (IE, THIS IS ADDED).
3. ALL REVISED INFORMATION IS FURTHER IDENTIFIED BY A HEAVY VERTICAL LINE TO THE RIGHT OF ALL REVISIONS IN EACH INDIVIDUAL SPECIFICATION SECTION (REFER TO HEAVY BOLD LINE TO THE RIGHT FOR AN EXAMPLE).

## VOLUME 1

### CIVIL, STRUCTURAL, ARCHITECTURAL

#### DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

	<input type="checkbox"/>	00 1115	Invitation to Bid
	<input type="checkbox"/>	00 2113	Instructions to Bidders
2019-11-01	<input type="checkbox"/>	00 3100	Available Project Information
	<input type="checkbox"/>	00 4100	Bid Form
	<input type="checkbox"/>	00 5200	Agreement Form
	<input type="checkbox"/>	00 6100	Bonds
2019-11-01	<input type="checkbox"/>	00 7200	General Conditions
	<input type="checkbox"/>	00 7300	Supplementary Conditions

#### DIVISION 01 - GENERAL REQUIREMENTS

<input type="checkbox"/>	01 0500	Design Selections
<input type="checkbox"/>	01 0510	Exterior Design Selections
<input type="checkbox"/>	01 0520	Interior Design Selections
<input type="checkbox"/>	01 1000	Summary
<input type="checkbox"/>	01 2100	Allowances
<input type="checkbox"/>	01 2200	Unit Prices
<input type="checkbox"/>	01 2300	Alternates

2019-11-01	<input type="checkbox"/>	01 2500	Substitution Procedures
2019-11-01	<input type="checkbox"/>	01 2500a	Substitution Procedure Form
2019-11-01	<input type="checkbox"/>	01 2600	Contract Modification Procedures
2019-11-01	<input type="checkbox"/>	01 2900	Payment Procedures
2019-11-01	<input type="checkbox"/>	01 2900a	Project Cost Summary Form
2019-11-01	<input type="checkbox"/>	01 3100	Project Management and Coordination
2019-11-01	<input type="checkbox"/>	01 3200	Construction Progress Documentation
	<input type="checkbox"/>	01 3233	Photographic Documentation
2019-11-01	<input type="checkbox"/>	01 3300	Submittal Procedures
2019-11-01	<input type="checkbox"/>	01 4000	Quality Requirements
	<input type="checkbox"/>	01 4200	References
2019-11-01	<input type="checkbox"/>	01 4323	Special Inspection
2019-11-01	<input type="checkbox"/>	01 4339	Visual Mock-Up Requirements
2019-11-01	<input type="checkbox"/>	01 4516	Field Test for Water Leakage
2019-12-06	<input checked="" type="checkbox"/>	01 4529	Testing Laboratory Services
2019-12-06	<input checked="" type="checkbox"/>	01 4534	Testing of Piping Systems
2019-11-01	<input type="checkbox"/>	01 5000	Temporary Facilities and Controls
2019-11-01	<input type="checkbox"/>	01 6000	Product Requirements
2019-11-01	<input type="checkbox"/>	01 7300	Execution
2019-11-01	<input type="checkbox"/>	01 7416	Clean Up (Site Maintenance)
2019-11-01	<input type="checkbox"/>	01 7419	Construction Waste Management and Disposal
	<input type="checkbox"/>	01 7420	LEED Construction Waste Management and Disposal
2019-11-01	<input type="checkbox"/>	01 7700	Closeout Procedures
2019-11-01	<input type="checkbox"/>	01 7823	Operations and Maintenance Data
2019-11-01	<input type="checkbox"/>	01 7839	Project Record Documents
2019-11-01	<input type="checkbox"/>	01 7900	Demonstration and Training
	<input type="checkbox"/>	01 8111	Sustainable Construction Requirements
	<input type="checkbox"/>	01 8112	LEED Construction Requirements
	<input type="checkbox"/>	01 8113	LEED Construction Requirements for New Construction and Major Renovations
	<input type="checkbox"/>	01 8123	LEED Construction Requirements for Commercial Interiors
	<input type="checkbox"/>	01 8133	LEED Construction Requirements for Core and Shell Development
	<input type="checkbox"/>	01 8143	LEED Construction Requirements for Schools
2019-11-01	<input type="checkbox"/>	01 9113	General Commissioning Requirements

## DIVISION 02 - EXISTING CONDITIONS

2019-11-01	<input type="checkbox"/>	02 1113	Demolition
2019-11-01	<input type="checkbox"/>	02 4116	Building Demolition
2019-11-01	<input type="checkbox"/>	02 4119	Selective Demolition

## DIVISION 03 - CONCRETE

<input type="checkbox"/>	03 0150	Concrete Patching
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2019-11-01	<input type="checkbox"/>	03 1000	Concrete Forming and Accessories
	<input type="checkbox"/>	03 1500	Concrete Accessories
2019-11-01	<input type="checkbox"/>	03 2000	Concrete Reinforcing
2019-12-06	<input checked="" type="checkbox"/>	03 2100	Steel Reinforcement (Sidewalk)
2019-11-01	<input type="checkbox"/>	03 3000	Cast-In-Place Concrete
2019-12-06	<input checked="" type="checkbox"/>	03 3053	Cast-in Place Concrete (Site work)
	<input type="checkbox"/>	03 3500	Concrete Finishing
2019-12-06	<input checked="" type="checkbox"/>	03 3536	Concrete Finishing (Site work)
	<input type="checkbox"/>	03 3543	Polished Concrete
	<input type="checkbox"/>	03 3600	Special Concrete Finishes
	<input type="checkbox"/>	03 3800	Post-Tensioned Concrete
2019-11-01	<input type="checkbox"/>	03 4000	Precast Concrete
2019-12-06	<input checked="" type="checkbox"/>	03 4500	Architectural Precast Concrete
	<input type="checkbox"/>	03 4713	Tilt-Up Concrete
	<input type="checkbox"/>	03 4900	Glass-Fiber Reinforced Precast Concrete (GFRC)
	<input type="checkbox"/>	03 5216	Lightweight Insulating Concrete
	<input type="checkbox"/>	03 5300	Concrete Toppings
	<input type="checkbox"/>	03 5416	Hydraulic Cement Underlayment

#### DIVISION 04 – MASONRY

2019-12-06	<input checked="" type="checkbox"/>	04 2100	Masonry Veneer
2019-11-01	<input type="checkbox"/>	04 2200	Reinforced Unit Masonry
	<input type="checkbox"/>	04 2300	Glass Unit Masonry
	<input type="checkbox"/>	04 4200	Exterior Stone Cladding
	<input type="checkbox"/>	04 4216	Steel Supported Stone Cladding
	<input type="checkbox"/>	04 7200	Cast Stone Masonry
	<input type="checkbox"/>	04 7500	Adhered Masonry Veneer

#### DIVISION 05 – METALS

2019-11-01	<input type="checkbox"/>	05 1000	Structural Steel
2019-11-01	<input type="checkbox"/>	05 1213	Architecturally Exposed Structural Steel (AESS)
	<input type="checkbox"/>	05 1636	Barrier Cables
2019-11-01	<input type="checkbox"/>	05 2100	Steel Joists Framing
	<input type="checkbox"/>	05 5214	Ornamental & Misc. Metals
2019-11-01	<input type="checkbox"/>	05 3000	Steel Decking
	<input type="checkbox"/>	05 3123	Steel Roof Deck System
	<input type="checkbox"/>	05 3133	Permanent Metal Forming
2019-11-01	<input type="checkbox"/>	05 4000	Cold-Formed Steel Framing
	<input type="checkbox"/>	05 4300	Slotted Channel Framing
2019-12-06	<input checked="" type="checkbox"/>	05 5000	Metal Fabrications
2019-11-01	<input type="checkbox"/>	05 5100	Metal Stairs
	<input type="checkbox"/>	05 5213	Pipe and Tube Railings
2019-12-06	<input checked="" type="checkbox"/>	05 5214	Ornamental & Misc. Metals
	<input type="checkbox"/>	05 5300	Metal Gratings
	<input type="checkbox"/>	05 5813	Ornamental Metal Column Covers
	<input type="checkbox"/>	05 7000	Ornamental Metal

05 7300 Ornamental Handrails and Railings

## DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

2019-12-06  06 1053 Miscellaneous Rough Carpentry  
2019-12-06  06 1643 Exterior Gypsum Sheathing  
2019-12-06  06 4023 Interior Architectural Woodwork  
 06 4223 Slatwall Paneling  
 06 6100 Simulated Stone Fabrications  
2019-12-06  06 6400 Plastic (FRP) Paneling  
 06 6413 Translucent Resin Panel Fabrications  
 06 6419 Simulated Stone Paneling  
 06 6713 Louvered Light Diffusers  
 06 6813 Plastic Gratings

## DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 0151 Preparation for Re-Roofing  
 07 0152 Patching of Existing Roofing  
 07 1114 Asphalt Mastic Dampproofing  
 07 1328 Pre-Applied Sheet Waterproofing  
 07 1352 Modified Bituminous Sheet Waterproofing  
 07 1413 Hot Fluid-Applied Rubberized Asphalt Waterproofing  
 07 1416 Cold Fluid Applied Waterproofing  
 07 1616 Crystalline Waterproofing  
 07 1700 Bentonite Waterproofing  
 07 1800 Traffic Coatings  
 07 1900 Water Repellents  
2019-12-06  07 2100 Thermal Insulation  
 07 2119 Spray-Applied Foam Insulation  
2019-12-06  07 2400 EIFS  
 07 2423 DEFS for Soffits  
2019-12-06  07 2500 Mechanically Fastened Air and Water Barriers  
2019-11-01  07 2600 Under-Slab Vapor Retarder  
 07 2613 Rubberized Asphalt Vapor Retarders  
 07 2713 Self-Adhering Air and Water Barriers  
 07 3113 Asphalt Shingles  
 07 3127 Simulated Slate Roofing  
 07 3200 Roof Tiles  
2019-12-06  07 4114 Metal Roof Panels  
 07 4213 Formed Metal Wall Panels  
 07 4229 Terra Cotta Wall Panels  
 07 4243 Composite Metal Wall Panels  
 07 4263 Insulated-Core Metal Wall Panels  
2019-12-06  07 5013 Single-Ply Membrane Roofing  
 07 5216 Modified Bituminous Membrane Roofing  
 07 5556 Fluid-Applied Protected Membrane Roofing  
 07 5563 Vegetated Protected Membrane Roofing  
2019-12-06  07 6200 Flashing and Sheet Metal  
 07 7200 Roof Accessories

	<input type="checkbox"/>	07 7600	Roof Pavers and Pedestal Assemblies
	<input type="checkbox"/>	07 8116	Cementitious Fireproofing
	<input type="checkbox"/>	07 8123	Intumescent Mastic Fireproofing
	<input type="checkbox"/>	07 8413	Penetration Firestopping
2019-12-06	<input checked="" type="checkbox"/>	07 8446	Fire-Resistive Joint Firestopping
	<input type="checkbox"/>	07 9100	Preformed Joint Seals
2019-12-06	<input checked="" type="checkbox"/>	07 9200	Joint Sealants
2019-12-06	<input checked="" type="checkbox"/>	07 9500	Expansion Control

## DIVISION 08 - OPENINGS

	<input type="checkbox"/>	08 0610	Door Schedule
2019-12-06	<input checked="" type="checkbox"/>	08 1113	Hollow Metal Doors and Frames
	<input type="checkbox"/>	08 1114	Interior Hollow Metal Frames
	<input type="checkbox"/>	08 1170	Steel Fire Door and Frame Assembly
	<input type="checkbox"/>	08 1216	Interior Aluminum Frames
2019-12-06	<input checked="" type="checkbox"/>	08 1416	Prefinished Flush Wood Doors
	<input type="checkbox"/>	08 1433	Stile and Rail Wood Doors
2019-12-06	<input checked="" type="checkbox"/>	08 3113	Access Doors and Frames
	<input type="checkbox"/>	08 3213	Sliding Aluminum-Framed Glass Doors
2019-12-06	<input checked="" type="checkbox"/>	08 3313	Coiling Counter Doors
2019-12-06	<input checked="" type="checkbox"/>	08 3323	Overhead Coiling Doors
	<input type="checkbox"/>	08 3326	Overhead Coiling Grilles
	<input type="checkbox"/>	08 3338	Interior Side Coiling Grilles
2019-12-06	<input checked="" type="checkbox"/>	08 3400	Special Function Doors
	<input type="checkbox"/>	08 3513	Folding Doors
	<input type="checkbox"/>	08 3515	Accordion Folding Fire Doors
	<input type="checkbox"/>	08 3613	Sectional Overhead Doors
	<input type="checkbox"/>	08 4110	Interior Storefront
	<input type="checkbox"/>	08 4127	Exterior All-Glass Entrances and Storefronts
	<input type="checkbox"/>	08 4128	Interior All-Glass Entrances and Storefronts
	<input type="checkbox"/>	08 4213	Exterior Aluminum Entrance Doors
	<input type="checkbox"/>	08 4216	Interior Aluminum Entrance Doors
	<input type="checkbox"/>	08 4229	Automatic Entrances
	<input type="checkbox"/>	08 4233	Revolving Entrance Doors
	<input type="checkbox"/>	08 4243	Medical Specialty Sliding Entrances
	<input type="checkbox"/>	08 4400	Glazed Aluminum Framing Systems
	<input type="checkbox"/>	08 4426	Structural Glass Curtainwall
	<input type="checkbox"/>	08 4500	Translucent Insulating Panel Assemblies
	<input type="checkbox"/>	08 5113	Aluminum Windows
2019-12-06	<input checked="" type="checkbox"/>	08 5619	Sliding Pass Windows
	<input type="checkbox"/>	08 5656	Bullet-Resistive Windows
	<input type="checkbox"/>	08 6200	Unit Skylights
	<input type="checkbox"/>	08 6300	Metal-Framed Skylights
2019-12-06	<input checked="" type="checkbox"/>	08 7100	Door Hardware
	<input type="checkbox"/>	08 7121	Interior Automatic Door Operators for Staff Use
	<input type="checkbox"/>	08 7122	Automatic Door Operators for the Disabled
2019-12-06	<input checked="" type="checkbox"/>	08 8000	Glazing
2019-12-06	<input checked="" type="checkbox"/>	08 8300	Unframed Mirrored Glazing
	<input type="checkbox"/>	08 8816	Between Glass Blinds Units
	<input type="checkbox"/>	08 8840	Switchable Privacy Glass Units
	<input type="checkbox"/>	08 9100	Wall Louvers

## DIVISION 09 – FINISHES

	<input type="checkbox"/>	09 0565	Floor Preparation for Renovation Work
	<input type="checkbox"/>	09 0600	Room Finish Schedule
	<input type="checkbox"/>	09 2300	Gypsum Plastering
	<input type="checkbox"/>	09 2400	Portland Cement Plastering
	<input type="checkbox"/>	09 2600	Veneer Plastering
	<input type="checkbox"/>	09 2613	Gypsum Veneer Plastering
	<input type="checkbox"/>	09 2713	GFRG Fabrications
2019-12-06	<input checked="" type="checkbox"/>	09 2900	Gypsum Board Assemblies
2019-12-06	<input checked="" type="checkbox"/>	09 3000	Tiling
2019-12-06	<input checked="" type="checkbox"/>	09 5113	Acoustical Panel Ceilings
	<input type="checkbox"/>	09 5133	Acoustical Metal Pan Ceilings
	<input type="checkbox"/>	09 5135	Snap-in Metal Pan Ceilings
	<input type="checkbox"/>	09 5423	Linear Metal Ceilings
	<input type="checkbox"/>	09 5436	Suspended Decorative Grids
2019-12-06	<input checked="" type="checkbox"/>	09 5451	Linear Wood Wall and Ceiling Systems
	<input type="checkbox"/>	09 6115	Concrete Floor Sealer
2019-12-06	<input checked="" type="checkbox"/>	09 6116	Liquid Floor Hardener
	<input type="checkbox"/>	09 6119	Moisture Floor Treatment
	<input type="checkbox"/>	09 6340	Stone Flooring
	<input type="checkbox"/>	09 6400	Wood Flooring
2019-12-06	<input checked="" type="checkbox"/>	09 6500	Resilient Flooring
2019-12-06	<input checked="" type="checkbox"/>	09 6513	Resilient Base and Accessories
	<input type="checkbox"/>	09 6520	Interlocking Rubber Tile Flooring
2019-12-06	<input checked="" type="checkbox"/>	09 6566	Resilient Athletic Flooring
	<input type="checkbox"/>	09 6603	Precast Terrazzo Flooring for Stairs
	<input type="checkbox"/>	09 6613	Thick-Set Terrazzo Flooring
	<input type="checkbox"/>	09 6623	Thin-Set Terrazzo Flooring
	<input type="checkbox"/>	09 6723	Resinous Flooring
2019-12-06	<input checked="" type="checkbox"/>	09 6800	Carpeting
	<input type="checkbox"/>	09 6900	Access Flooring
	<input type="checkbox"/>	09 7200	Wall Covering
	<input type="checkbox"/>	09 7213	Tackboard Wall Coverings
	<input type="checkbox"/>	09 7500	Interior Stone Facing
	<input type="checkbox"/>	09 7723	Fabric Wrapped Panels
	<input type="checkbox"/>	09 8433	Acoustical Wall Panels
2019-12-06	<input checked="" type="checkbox"/>	09 9100	Painting
	<input type="checkbox"/>	09 9413	Textured Interior Coatings
	<input type="checkbox"/>	09 9600	High-Performance Coatings
	<input type="checkbox"/>	09 9613	Multicolored Interior Coatings
	<input type="checkbox"/>	09 9653	Elastomeric Coatings
	<input type="checkbox"/>	09 9663	Textured Acrylic Coating

## DIVISION 10 - SPECIALTIES

	<input type="checkbox"/>	10 1100	Visual Display Boards
	<input type="checkbox"/>	10 1146	Visual Display Fabrics
2019-12-06	<input checked="" type="checkbox"/>	10 1400	Interior Signage

	<input type="checkbox"/>	10 1443	Photoluminescent Exit Path Marking System
	<input type="checkbox"/>	10 1700	Telephone Specialties
2019-12-06	<input checked="" type="checkbox"/>	10 2113	Toilet Compartments
2019-12-06	<input checked="" type="checkbox"/>	10 2115	Cubicle Specialties
	<input type="checkbox"/>	10 2213	Wire Mesh Partitions
	<input type="checkbox"/>	10 2223	Accordion Folding Partitions
2019-12-06	<input checked="" type="checkbox"/>	10 2238	Operable Panel Partition
	<input type="checkbox"/>	10 2239	Vertically Folding Panel Partitions
2019-12-06	<input checked="" type="checkbox"/>	10 2613	Wall and Corner Guards
2019-12-06	<input checked="" type="checkbox"/>	10 2813	Toilet Accessories
	<input type="checkbox"/>	10 2819	Shower Doors and Enclosures
	<input type="checkbox"/>	10 4116	Emergency Key Cabinets
2019-12-06	<input checked="" type="checkbox"/>	10 4400	Fire Protection Specialties
	<input type="checkbox"/>	10 4450	Automated External Defibrillators (AED)
2019-12-06	<input checked="" type="checkbox"/>	10 5113	Metal Lockers
	<input type="checkbox"/>	10 5116	Wood Lockers
	<input type="checkbox"/>	10 5503	USPS-Delivery Postal Specialties
	<input type="checkbox"/>	10 5506	Private-Delivery Postal Specialties
	<input type="checkbox"/>	10 5713	Wall Mounted Coat Rack and Shelf
	<input type="checkbox"/>	10 7113	Exterior Sun Control Devices
2019-12-06	<input checked="" type="checkbox"/>	10 7310	Aluminum Walkways and Canopies
	<input type="checkbox"/>	10 7500	Flagpoles

#### DIVISION 11 - EQUIPMENT

2019-12-06	<input checked="" type="checkbox"/>	11 1300	Loading Dock Equipment
	<input type="checkbox"/>	11 2400	Building Maintenance Equipment
	<input type="checkbox"/>	11 5213	Projection Screens
2019-12-06	<input checked="" type="checkbox"/>	11 7000	Medical Equipment
	<input type="checkbox"/>	11 7313	Wall-Mounted Fold-Up Writing Surface
	<input type="checkbox"/>	11 7316	Wall-Mounted Chart Rack

#### DIVISION 12 - FURNISHINGS

	<input type="checkbox"/>	12 2113	Horizontal Louver Blinds
	<input type="checkbox"/>	12 2116	Vertical Louver Blinds
2019-12-06	<input checked="" type="checkbox"/>	12 2413	Roller Window Shades
	<input type="checkbox"/>	12 2500	Between Glass Blinds
	<input type="checkbox"/>	12 3553	Laboratory Casework
	<input type="checkbox"/>	12 3571	Stainless Steel Casework
	<input type="checkbox"/>	12 3640	Stone Countertops
2019-12-06	<input checked="" type="checkbox"/>	12 3661	Simulated Stone Countertops
	<input type="checkbox"/>	12 4816	Entrance Floor Grilles
	<input type="checkbox"/>	12 4843	Entrance Floor Mats
	<input type="checkbox"/>	12 6300	Stadium Seating
	<input type="checkbox"/>	12 9313	Bicycle Racks

#### DIVISION 13 - SPECIAL CONSTRUCTION

	<input type="checkbox"/>	13 2817	Ballpark Netting and Supports
	<input type="checkbox"/>	13 3448	Pre-Fabricated Rooftop Helipad

- 13 4900 Radiation Protection
- 13 4923 RF/MRI Modular Shielding Enclosure

## DIVISION 14 - CONVEYING EQUIPMENT

- 14 1000 Dumbwaiters
- 2019-12-06  14 2100 Electric Traction Elevators
- 14 2400 Hydraulic Elevators
- 14 3100 Escalators
- 14 9100 Chutes
- 14 9200 Pneumatic Tube Systems

## DIVISION 31 - EARTHWORK

- 2019-11-01  31 1100 Cleaning and Grubbing
- 31 2119 Site Grading
- 2019-11-01  31 2300 Excavation & Fill
- 2019-11-01  31 2311 Earthwork for Building Construction
- 2019-12-06  31 2333 Trenching
- 2019-11-01  31 2500 Erosion Control
- 2019-11-01  31 2573 Temporary Silt Fence
- 2019-12-06  31 3116 Termite Control
- 2019-12-06  31 4134 Excavation/Trench & Shore
  
- 31 6218 Mini-Piles
- 2019-11-01  31 6613 Aggregate Piers

## DIVISION 32 - EXTERIOR IMPROVEMENTS

- 2019-12-06  32 1123 Aggregate Base Course
- 2019-12-06  32 1313 Concrete Paving
- 32 1413 Interlocking Precast Concrete Paving
- 32 1416 Brick unit Paving
- 32 1440 Stone Paving
- 2019-12-06  32 1613 Concrete Curb & gutters
- 2019-12-06  32 1614 Concrete Side Walk
  
- 32 1715 Parking Accessories
- 32 3113 Chain Link Fencing
- 32 3115 Tubular Steel Fencing
- 32 3117 Gate Operators
- 32 3121 Cable Guardrail System
- 2019-12-06  32 3223 Segmental Retaining Walls

## DIVISION 33 - UTILITIES

- 2019-12-06  33 0516 Manholes Vaults
- 2019-12-06  33 0526 Utility Line Marking
- 2019-12-06  33 0527 Connection to Existing Utilities
- 2019-12-06  33 0533 Plastic Pipe (water & San. Swr.)

2019-12-06	<input checked="" type="checkbox"/>	33 1113	HDPE Potable Water Pipe
2019-12-06	<input checked="" type="checkbox"/>	33 1216	Valves
2019-12-06	<input checked="" type="checkbox"/>	33 1219	Hydrants
2019-12-06	<input checked="" type="checkbox"/>	33 1300	Disinfection of Waterlines
2019-12-06	<input checked="" type="checkbox"/>	33 4100	Storm Drainage

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## SECTION 01 45 29 - TESTING LABORATORY SERVICES

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Requirements for the Contractor to engage a qualified, independent testing laboratory to conduct specific tests, where the Contractor is required to do so in this contract. List of tests and schedule below is to be considered a minimum. Additional testing may be required to insure quality. Contractor shall obtain and review reports or recommendations prepared by professional consultants such as Geotechnical Engineers, Structural Engineers or other consultants for additional or more stringent requirements for testing. This section is only intended to be applied to sitework construction. Refer to Architectural/Structural documents for testing related to building, building foundation or other architectural items.

#### 1.2 SUBMITTALS

- A. Test Reports: The Contractor shall provide 4 copies of test reports to the Owners Representative. Reports shall include testing facility name, address, telephone number, and names of full-time responsible officers.

#### 1.3 QUALITY ASSURANCE

- A. Approval of Laboratory: The qualified, independent testing laboratory, which will be conducting the specific tests required in this contract, must have authority or be licensed to operate in the State in which the project is located. The testing laboratory shall be approved by the Owners Representative prior to the Contractor beginning work.
- B. Responsibilities of Laboratory:
  - 1. Test samples of mixes submitted by the Contractor.
  - 2. Provide qualified personnel at project site. Cooperate with the Owners Representative and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products and materials in accordance with specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of specifications.
  - 5. Promptly notify the Owners Representative and Contractor of observed irregularities or non-conformance of work, products, or materials.
  - 6. Attend preconstruction meetings and progress meetings, if requested.
- C. Limitations on Laboratory:
  - 1. Laboratory may not release, revoke, alter, or enlarge on requirements of specifications or technical recommendations.
  - 2. Laboratory may not approve or accept partial portions of the work.
  - 3. Laboratory may not assume duties of the Contractor unless approved in writing by the Owners Representative.

#### 1.4 SEQUENCING AND SCHEDULING

- A. Establishing Testing Schedule:
  - 1. By advance discussion with the testing laboratory, determine the time required for the laboratory to perform its test and to issue its findings.
  - 2. Provide required time within the construction schedule.
- B. Revising Testing Schedule: When construction schedule changes are necessary during construction, coordinate such changes with the testing laboratory as required.

**PART 2: PRODUCTS**

- A. Reports: Shall include:
  - 1. Date issued.
  - 2. Project title and number.
  - 3. Name of inspector.
  - 4. Date and time of sampling or inspection.
  - 5. Identification of product and specification sections.
  - 6. Location in the Project.
  - 7. Type of inspection or test.
  - 8. Date of test.
  - 9. Results of tests.
  - 10. State conformance or non-conformance with Contract Documents.
  
- B. Interpretation: When requested by the Owners Representative, provide interpretation of test results.

**PART 3: EXECUTION**

**3.1 FIELD QUALITY CONTROL**

- A. Contractor Requirements: See individual specifications "Field Quality Control" paragraph for specific testing requirements. When applicable, the Contractor shall:
  - 1. Deliver to agency or laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
  - 2. Cooperate with laboratory personnel, and provide access to the Work.
  - 3. Provide incidental labor and facilities:
    - a. To obtain, handle, and label or identify samples at the site or at source of products and materials to be tested.
    - b. To facilitate tests.
    - c. To provide storage and curing of test samples.
  - 4. Ensure samples are taken by qualified testing personnel.
  - 5. Coordinate the laboratory test frequency and timing with the Owners Representative.
  - 6. Ensure tests are completed according to the testing schedule.
  - 7. Furnish test reports within 7 working days after tests have been completed.

B. Building and Bridge Field Testing:

<u>Item</u>	<u>Location</u>	<u>Reference</u>	<u>Frequency</u>	<u>Remarks</u>
Structural Fill	foundation	AASHTO T 238	1/1500 sf or 4 Tests per 8- inch Lift min.	field density & moisture content
Structural Fill	source	AASHTO T 248	1/soil type	field sample/ splitting
Structural Fill	source	AASHTO T 90 type	1/soil	plastic index
Embankment	foundation	AASHTO T 238	1/2500 sf per lift	field density & moisture content

Embankment	source	AASHTO T 248	1/soil type	field sample/ splitting
Embankment	source	AASHTO T 90	1/soil type	plastic index
Aggregate	under floor slab	AASHTO T 27	1/source	plastic index
Aggregate	under floor slab	AASHTO T 238	1/1500 sf per lift	field density and moisture content
Concrete	structural	ASTM C 31	1 set/50 cubic yards or per day	cylinder; 1 set= 4 cylinders
Concrete	structural	ASTM C 143	1/truck	slump
Concrete	structural	ASTM C 2311/truck		air content fresh concrete

C. Roads/Streets Field Testing:

<u>Item</u>	<u>Location</u>	<u>Reference</u>	<u>Frequency</u>	<u>Remarks</u>
Subgrade	along centerline	AASHTO T 145	1/5000 sf	AASHTO soil classification
Subgrade	left shoulder centerline right shoulder	AASHTO T 238	1 test/5000 sf or 8-inch lift	in-place density and moisture content
Subbase/left shoulder Base centerline		AASHTO T 238	1/5000 sf	in-place density and moisture content
Asphalt	finished	AASHTO T 230	1/5000 sf	in-place density

D. Parking Area Field Testing:

<u>Item</u>	<u>Location</u>	<u>Reference</u>	<u>Frequency</u>	<u>Remarks</u>
Subgrade	source	AASHTO T 45	1/soil class	AASHTO soil
Subgrade	random	AASHTO T 238	1/2500 sf or 8-inch lift	in-place density
Subbase Base pattern	random	AASHTO T 238	1/2500 sf	in-place density and moisture content
Asphaltic pattern	random	AASHTO T 230 ASTM D 2950	1/250 tons	in-place density

E. Building and Bridge Laboratory Testing:

<u>Item</u>	<u>Location</u>	<u>Reference</u>	<u>Frequency</u>	<u>Remarks</u>
Structural	source	AASHTO T 99	1/soil class	moisture/density Fill
Structural Fill	source	AASHTO T 27	1/soil class	sieve analysis/ unified soil classification
Aggregate	underfloor	AASHTO T 27	1/source	sieve analysis
Embankment	source	AASHTO T 99	1/soil class	moisture/density relationship
Embankment	source	AASHTO T 27	1/soil class	sieve analysis
Concrete cylinder		ASTM C 39	1/set	cylinder compressive strength

F. Roads/Streets Laboratory Testing:

<u>Item</u>	<u>Location</u>	<u>Reference</u>	<u>Frequency</u>	<u>Remarks</u>
Subbase/crusher or Base	stockpile	AASHTO T 27	1/1000 tons or 1/day	sieve analysis
Subgrade	embankment	AASHTO T 99 or T 180	1/soil class	moisture/density relationship
Subbase/source		AASHTO T 180	1/source	moisture/density relationship
Subbase/random Base		AASHTO T 27	1/1000 tons	sieve analysis
Asphalt Concrete	haul truck	AASHTO T 164 ASTM D 2172	1/250 tons	% asphalt in mix
Asphalt Concrete	haul truck	AASHTO T 27	1/250 tons	sieve analysis

G. Utility Trench:

<u>Item</u>	<u>Location</u>	<u>Reference</u>	<u>Frequency</u>	<u>Remarks</u>
Backfill	Trench	AASHTO T 238	1/150 lf of trench per lift	in place moisture/density

### 3.2 POST-TENSIONING OF CONCRETE

- A. Inspection Prior to Concreting: Inspect tendons, drape of tendons, and plates for compliance prior to concreting.

- B. Concrete Testing: As required in this section except make three test cylinders representing each area to be tensioned and cylinders shall be cured in the same manner as the concrete they represent. Make compression test prior to determine minimum specified strength required for post-tensioning.
- C. Post-tensioning: Observe post-tensioning operation and record actual force and elongation applied to each tendon.
- D. Submit a report for the following:
  - 1. Inspection of placement and post-tensioning of all strands.
  - 2. Size, number, location, and drape of strands and the post-tensioning loads imposed. Check elongation of tendons within ranges established by manufacturer.
- E. Compression Test Reports:
  - 1. Furnish certified compression test report to the Owners Representative. On test report indicate following information:
    - a. Cylinder identification number and date cast.
    - b. Specific location at which test samples were taken.
    - c. Type of concrete, slump, and percent air.
    - d. Compressive strength of concrete in psi.
    - e. Weight of lightweight structural concrete in pounds per cubic feet.
    - f. Weather conditions during placing.
    - g. Temperature of concrete in each test cylinder when test cylinder was molded.
    - h. Maximum and minimum ambient temperature during placing.
    - i. Ambient temperature when concrete sample in test cylinder was taken.
    - j. Date delivered to laboratory and date tested.

### 3.3 FLOOR SLABS

- A. Test flatness and levelness according to ASTM E 1155.

### 3.4 CONCRETE REINFORCEMENT

- A. Provide manufacturers mill certification and test report.

### 3.5 SHOTCRETE

- A. Inspection and Material Testing:
  - 1. Provide field inspection and testing service to certify that shotcrete has been applied according to drawings and specifications.
  - 2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to the Owners Representative.
  - 3. Sample and test mix ingredients as necessary to insure compliance with specifications.
  - 4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to the Owners Representative.
  - 5. Certify that ingredients and proportions and amounts of ingredients in shotcrete conform with approved trial mixes.
- B. Shotcrete Sampling:
  - 1. Provide a technician at site of placement to perform shotcrete sampling.
  - 2. Take cores according to ACI 506R.
  - 3. Insure maintenance of water-cement ratio established by approved trial mix.
  - 4. Verify specified mixing has been accomplished.
- C. Laboratory Tests of Field Sample Panels:

1. Test compression test core for strength according to ACI 506R. For each test series of three cores, test one core at 7 days and one core at 28 days. Use the remaining core as a spare to be tested at either 7 or 28 days as required. Compile laboratory test reports as follows: Compressive strength test shall be the result of one core, except when the one core shows evidence of improper sampling or testing, in which case it shall be discarded and strength of the spare core shall be used.
  2. Submit certified compression test reports to the Owners Representative. On the test report, indicate the following information:
    - a. Core identification number and date cast.
    - b. Specific location at which test samples were taken.
    - c. Compressive strength of shotcrete in psi.
    - d. Weather conditions during placing.
    - e. Temperature of shotcrete in each test core when test core was taken.
    - f. Maximum and minimum ambient temperature during placing.
    - g. Ambient temperature when shotcrete sample was taken.
    - h. Date delivered to laboratory and date tested.
- D. Submit inspection reports certification and instances of noncompliance to the Owners Representative.

### 3.6 MORTAR AND GROUT

- A. Take and test samples of mortar and grout according to ASTM C 91 for conformance with specified strength requirements.

### 3.7 STRUCTURAL STEEL

- A. Provide shop and field inspection and testing services to certify structural steel work is done in according to drawings and specifications.
  1. Welding shall conform with AWS D1.1 Structural Welding Code.
  2. Prefabrication Inspection:
    - a. Review design and shop detail drawings for size, length, type and location of all welds to be made.
    - b. Approve welding procedure qualifications either by prequalification or by witnessing qualifications tests.
    - c. Approve welder qualifications either by certification or retesting.
    - d. Approve procedure for control of distortion and shrinkage stresses.
    - e. Approve procedures for welding according to applicable portions of Section 4, AWS D1.1.
  3. Fabrication and Erection:
    - a. Inspect welding equipment for capacity, maintenance and working condition.
    - b. Verify specified electrodes and handling and storage of electrodes according to AWS D1.1
    - c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
    - d. Inspect preheating and interpass temperatures for conformance with Table 4.2, AWS D1.1.
    - e. Verify that quality of welds meet the requirements of Paragraph 10.17, AWS D1.1. Verify quality of shop and field butt welds greater than 1/2 inch by ultrasonic procedure. Ultrasonic procedure shall conform to Section 6, Part C, AWS D1.1.
    - f. Correction of rejected welds shall be made in according to Paragraph 3.7, AWS D1.1.
    - g. Inspect high-strength bolted connections according to AISC M 017 using ASTM A 325 or A 490 bolts.

- B. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to the Owners Representative.

END OF SECTION

## SECTION 01 45 34 - TESTING OF PIPING SYSTEMS

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Testing of pressure water/sewer lines and gravity sewer system lines.

#### 1.2 QUALITY ASSURANCE

- A. Flow meters shall record the actual volume plus or minus 2 percent.
- B. Air test gauges shall be ANSI B40.1-80, Grade 3A (plus or minus 0.25 percent of full scale accuracy), 15 psi dial range.
- C. Water test gauges shall be ANSI B40.1-80, Grade 2-A (plus or minus 0.5 percent of full scale accuracy), dial range approximately twice the required test pressure.

#### 1.3 SUBMITTALS

- A. As specified in General Conditions, or if specifically requested by Owners Representative.
  - 1. Accuracy certification by approved independent testing laboratories for flow meters and test gauges. Certifications shall be dated no more than 90 days before actual system testing.
  - 2. Before testing, provide the following information:
    - a. All Tests: Describe precautions that will be taken to protect system equipment that might be damaged under test pressures, and the proposed method for rerouting sewer flows where the system must remain in service.
    - b. Air Sewer Tests: Describe the proposed method for testing where existing sewer service laterals enter the main being tested. Describe safety devices on air test equipment, and personnel safety precautions during air tests.

#### 1.4 PROJECT CONDITIONS

- A. Testing shall not be performed until each system has been flushed or thoroughly cleaned in accordance with procedures in the sections that describe line installation.
- B. Test potable water lines before disinfecting.

#### 1.5 CONTRACTOR'S OPTION

- A. For gravity sewer lines the Contractor may use either the water leakage or air test.

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. Testing Water: Shall be suitable for drinking unless otherwise approved in writing by the Engineer before use. Owner will provide to the Contractor water for filling lines and making tests at a rate equal to the Owner's cost.

### PART 3: EXECUTION

#### 3.1 GENERAL

- A. Testing: Conduct the performance and acceptance tests of the piping systems. Furnish necessary equipment, labor, and materials to conduct the testing. Testing shall be conducted in



the presence of the Owner's Representative after backfilling and compaction are complete. Contractor shall provide any incidental taps, corp stops, temporary valves, temporary plugs, fittings etc. necessary to perform testing at no cost to the Owner.

- B. Notification: Notify the Owner's Representative at least 24 hours prior to testing.
- C. Procedure: Prior to testing, remove equipment which would be damaged by the test pressure from the system in which it is installed. Ensure thrust blocks have sufficiently cured. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, previously tested portions shall become a part of the later test of the composite system. Repair leaks. Test time will be accrued only while full test pressure is exerted or subjected on the system.

### 3.2 PRESSURE WATER/SEWER LINES

- A. Filling Line: Fill line with water slowly and eliminate air in the line. A pump connected to the pipe shall provide the specified test pressure, measured at the point of lowest elevation. Contractor shall furnish pump, pump connection and all necessary apparatus including gauges and meters to complete the test.
- B. Test Pressure: Maintain pressure of 150 percent of maximum anticipated operating pressure or the maximum working pressure of the pipe, whichever is greater, on the section being tested. The duration of the test shall be 30 minutes after the line has been brought up to test pressure. If the line sustains less than 5% pressure drop within the 30 minute period, a leakage test of two hours duration shall be performed. Should any test of pipe in place disclose leakage than that specified, the Contractor shall, at his own expense, locate and repair the defective joints, pipe or fitting, repeat test until leakage is within the specified allowances.
- C. Leakage: Leakage is defined as the quantity of make-up water supplied into the newly laid pipe, or any valved section of it, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and air expelled, as stated above. Do not use paints, asphalts, tars, or other types of pipe compounds to eliminate leaks. No pipe installation shall be accepted until leakage does not exceed 10 gallons per inch of pipe diameter per mile of pipe per 24 hours at 150 psi, which is tabulated below:

Pipe Diameter (Inches)	Allowable Leakage (Gal. per 2 Hr. per 1000 ft.)
1 ½	0.24
2	0.32
2 ½	0.39
3	0.47
4	0.63
6	0.95
8	1.26
10	1.58
12	1.89

### 3.3 GRAVITY SEWER

- A. General: Perform water or air leakage and light tests as specified below. A finished plumbing test, as indicated below, shall be performed on building gravity sewer lines, drain lines, and vent systems. Lines shall be flushed clean prior to testing. All wyes, tees, stubs and service laterals shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal pressure. Such plugs or caps shall be readily removable. All lines will be tested.

B. Tests for Lines Located Inside Buildings

1. Water Test: The water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, openings in the piping shall be tightly closed, except the highest opening. The system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test. Each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next-preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet of the system) shall have been subjected to a test of less than a 10-foot head of water. The water shall remain in the system, or in the portion under test, for at least 1 hour before inspection starts. The system shall not leak. The test-water level shall be maintained to within 1 inch during the test period.
3. Finished Plumbing: After the plumbing fixtures have been installed and the traps filled with water, the connections shall be tested and proved watertight. This test shall consist of flushing water closets, urinals, and discharging full lavatory's and other fixtures through the system.

C. Tests for Lines Located Outside of Buildings & Public Lines

1. Exfiltration Test: Make leakage test upon the completion of each pipe section between manholes by closing the lower end of the section to be tested and the inlet sewer of the upper manhole with stoppers, inflatable plugs or by other means approved by the Engineer. Fill the pipe and manhole with water to completely fill the pipe to an elevation two (2) feet above the top of pipe or 2 feet above groundwater elevation, whichever is greater. The Contractor shall fill the pipe to the test level prior to the time of exfiltration testing to permit normal absorption into the pipe walls. Duration of the test shall be two hours. No section of sewer will be accepted until exfiltration does not exceed 10 gallons per inch diameter per mile per 24 hours, as tabulated below. When leakage in excess of this amount is detected repairs shall be made and the line successfully retested before acceptance of the sewer.

Pipe Diameter (Inches)	Allowable Leakage (Gal. per 2 Hr. per 1000 ft of pipe)
6	0.95
8	1.26
10	1.58
12	1.89
15	2.37
18	2.84

2. Air Testing: Flush clean the section to be tested. Seal and isolate the section to be tested with plugs or stoppers. Determine the test duration for the section under the test by computation from the applicable equations shown in ASTM C-828, or from prepared air test tables. The pressure holding time is based on an average holding pressure of 3 psi (21kPa) gage or a drop from 3.5 psi (24 kPa) to 2.5 psi (17 kPa) gage.

Add air until the internal pressure of the sewer line is raised to approximately 4.0 psi (28kPa) gage. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes. When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gage, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psi. Record the drop in pressure for

the test period. If the pressure has dropped more than 1.0 psi gage during the test period, the line is presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psi drop has not occurred.

The following table has been prepared utilizing applicable equations from ASTM C-828. It is based on an allowable air loss of 0.0015 cf/min/sf of internal pipe surface, a maximum air loss per test section of 3.5 cf/min. The table applies when testing one pipe diameter only throughout the test section and ignores 4-inch and 6-inch lateral sewers.

**AIR TEST TABLE  
MINIMUM TEST TIME FOR VARIOUS PIPE SIZES**

Nominal Pipe Size, Inches	T (time) min/100 ft.	Nominal Pipe Size, Inches	T (time) min/100 ft.
4	3.77	24	22.78
6	5.67	27	28.85
8	7.57	30	35.62
10	9.43	36	51.28
12	11.33		
15	14.17		
18	17.00		

The test may be used as a presumptive test to enable the installer to determine the acceptability of the line prior to backfill and subsequent construction activities. However, testing for acceptance by the Owner will only be performed after backfill and compaction.

The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way to prevent blowouts. As a safety precaution, pressurizing equipment may include a regulator or relief valve to avoid over pressurizing and damaging an otherwise acceptable line. Personnel shall not be allowed to enter manholes during the test procedure.

Should a test on sections of pipeline have an air loss rate greater than that permitted, locate and repair the defective joints or pipes and retest until the air loss rate is within the specified allowance as shown in the table above.

4. Light Test: Light held in pipe at one manhole shall be visible from next manhole as a full circle of light.
5. Deflection Testing: Thirty days after backfill operations, PVC sewer pipe shall be measured for vertical deflection using a deflection testing mandrel. Maximum ring deflection of the installed pipe shall be limited to 5% of the average inside diameter as defined by ASTM D2680. All pipe exceeding the allowable deflection shall be replaced by the Contractor at no additional cost to the Owner.

END OF SECTION

## SECTION 03 21 00 - STEEL REINFORCEMENT(SITEWORK)

### 1.0 GENERAL

#### 1.1 DESCRIPTION

1.1.1 Work included: Provide concrete reinforcement where shown on the drawings specified herein, and as needed for a complete and proper installation.

1.1.2 Related Work:  
Division 03 30 53: Cast-in-Place Concrete

#### 1.2 QUALITY ASSURANCE

1.2.1 Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.

1.2.2 Comply with pertinent provisions of the following, except as may be modified herein:

- A. ACI 318
- B. CRSI "Manual of Standard Practice"

#### 1.3 SUBMITTALS

1.3.1 Comply with pertinent provisions of General Conditions.

1.3.2 Product data: After the Contractor has received the Owner's Notice of Award, submit:

- A. Materials list of items proposed to be provided under this Division.
- B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
- C. Shop Drawings showing details of bars, anchors, and other items, if any, provided under this Division.

#### 1.4 PRODUCT HANDLING

1.4.1 Delivery and Storage:

- A. Use necessary precautions to maintain identification.
- B. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.

### 2.0 PRODUCTS

#### 2.1 REINFORCEMENT MATERIALS AND ACCESSORIES

2.1.1 Bars: Provide deformed billet steel bars complying with ASTM A615, using grades shown on the Plans. Grade 60 unless otherwise noted.

2.1.2 Steel Wire:

- A. Comply with ASTM A82.

B. For tie wire, comply with Fed Spec QQ-W-461, annealed steel, black, 16 gage minimum.

2.1.3 Welded Wire Fabric: Provide welded steel, complying with ASTM A185. Sheets only.

2.1.4 Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcement in place:

- A. Use wire bar type supports complying with CRSI recommendations, unless otherwise shown on the Plans.
- B. Do not use wood, brick, or other non-complying material.
- C. For slabs on grade, use supports with sand plates or horizontal runners where base materials will not support chair legs.

## 2.2 FABRICATION

2.2.1 Fabricate reinforcing bars to conform to the required shapes and dimensions, with fabrication tolerances complying with the CRSI Manual.

2.2.2 In case of fabricating errors, do not straighten or rebend reinforcement in a manner that will weaken or injure the material.

2.2.3 Reinforcement with any of the following defects will not be acceptable:

- A. Bar lengths, depths, and/or bends exceeding the specified fabrication tolerances.
- B. Bends and/or kinks not shown on the Plans.
- C. Bars with reduced cross-section due to excessive rusting or other cause.

## 3.0 EXECUTION

### 3.1 SURFACE CONDITIONS

Examine the areas and conditions under which work of this Division will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

3.2.1 General:

- A. Comply with the specified standards for detail and method of placing reinforcement and supports, except as many be modified herein.
- B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
- C. Position, support, and secure reinforcement against displacement by formwork, construction, and concrete placing operations.
- D. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
- E. Place reinforcement to obtain minimum coverages for concrete protection.

- F. Arrange, space, and securely tie bars and bar supports together with the specified tie wire.
- G. Set wire ties so twisted ends are directed away from exposed concrete surfaces.

3.2.2 Install welded fabric in as long lengths as practicable, lapping adjoining pieces at least one full mesh.

3.2.3 Provide sufficient numbers of supports, and of strength to carry the reinforcement.

3.2.4 Do not place reinforcing bars more than 2" beyond last leg of any continuous bar support.

3.2.5 Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

### 3.3 SPLICES

3.3.1 Lap Splices: Tie securely with the specified wire to prevent displacement of splices during placement of concrete.

3.3.2 Splice Devices:

- A. Obtain approval from the Owner's Representative prior to using splice devices.
- B. Install in accordance with manufacturer's written instructions.
- C. Splice in a manner developing at least 125% of the yielding strength of the bar.

3.3.3 Welding: Is not permitted unless otherwise noted. If otherwise noted, then perform in accordance with AWS D1.4-79.

3.3.4 Do not splice bars except at locations shown on the drawings, or as otherwise specifically approved by the Owner's Representative.

### 3.4 TESTING

Materials to be sampled at the building site shall have been delivered thereto at least 72 hours before needed.

END OF SECTION

## SECTION 03 30 53 - CAST-IN-PLACE CONCRETE (SITEWORK)

### 1.0 GENERAL

#### 1.1 DESCRIPTION

- 1.1.1 This section covers all cast-in-place concrete, including, forms, finishing, curing and other appurtenant work.
- 1.1.2 Transit mix concrete will be permitted if it meets the requirements of this section and is mixed and delivered in accordance with ASTM C94.

### 2.0 MATERIALS

#### 2.1 GENERAL

Cement: ASTM C150, Type I or III unless otherwise noted;  
Coarse Aggregate: Crushed rock, washed gravel or other inert material conforming to ASTM C33;  
Water: Potable, clean and free from deleterious substances;  
Reinforcing Steel: ASTM A615, Grade 60; unless otherwise noted;  
Welded Wire Fabric: ASTM A185;  
Forms: (No wood rot or deteriorated wood shall be accepted)  
    Plywood - Waterproof, resin-bonded, exterior type, face to concrete Grade B or better;  
    Lumber - Straight, uniform width and thickness and free from knots, offsets, holes, dents and other surface defects;  
    Chamfer Strips -3/4" clear white pine, surface against concrete planed;  
Form Coating - Industrial lubricants "Non-Crete" form coating, Protex "Pro-Cote" or equal;  
Expansion Joints - Preformed, bituminous type ASTM D994, unless otherwise noted;  
Air Entraining Admixture: ASTM C60  
Water Reducing Admixture: ASTM C494 Type A,  
Fly Ash: No more than 15% cement replacement  
Moisture Retaining Cover: Polyethylene film, or polyethylene coated burlap meeting ASTM C171.

#### 2.2 PROPERTIES

The minimum concrete compressive strength as determined by ASTM C39 shall be:

Minimum Strength: 3,500 psi at 28 days, unless noted otherwise  
Air Entrainment: 4-6% ( in all concrete)  
Water Reducer: ASTM C494 Type A in all concrete  
Calcium Chloride: Not Permitted  
All admixtures, except High Range Water Reducers, shall be added to the concrete at the batch plant.

#### 2.3 BATCHING AND MIXING

- 2.3.1 Mix design shall be in accordance with ACI-301, Section 4. Each mix design shall be submitted to Owner's Representative for approval prior to incorporation into the project. Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

- 2.3.2 The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

### 3.0 EXECUTION

#### 3.1 GENERAL

- 3.1.1 The limits of each concrete pour shall be predetermined by the Contractor and shall be acceptable to the Owner. Limitations shall be in accordance with ACI recommendations, unless otherwise approved, in writing, by the Owner. All concrete within such limits shall be placed in one continuous operation.
- 3.1.2 Placement shall comply with AI 301. Before concrete is placed, forms, reinforcements, water stops, anchor bolts and embedments shall be rigidly secured in proper position; all dirt, mud, water and debris shall be removed from the space to be occupied by concrete; all surfaces encrusted with dried concrete from previous placement operations shall be cleaned.
- 3.1.3 Concrete shall be conveyed to the point of final deposit by methods which prevent separation or loss of ingredients. Concrete shall be placed in final position without being moving laterally in the forms more than 5 feet.
- 3.1.4 Footings shall be poured separately from the slab.

#### 3.2 HOT WEATHER CONCRETING

- 3.2.1 Except as modified herein, hot weather concreting shall comply with ACI 305. At air temperatures of 90F or above, concrete shall be kept as cool as possible during placement and curing. The temperature of the concrete when placed in the work shall not exceed 90F. Retempering with water is not allowed.
- 3.2.2 Plastic shrinkage cracking, due to rapid evaporation of moisture, shall be prevented. Concrete shall not be placed when the evaporation rate (actual or anticipated) equals or exceeds 0.2 lbs per sq. ft. per hour, as determined by The American Concrete Institute.

#### 3.3 COLD WEATHER CONCRETING

- 3.3.1 Except as modified herein, cold weather concreting shall comply with ACI 306. The temperature of concrete at the time of mixing shall be not less than that shown in the following table for corresponding outdoor temperature (in shade) existing at the time of placement.

Outdoor Temperature	Concrete Temperature
Below 10F	70F
Between 10F and 45F	60F
Above 45F	45F

- 3.3.2 When placed, heated concrete shall not be warmer than 80F.
- 3.3.3 When freezing temperatures may be expected during the curing period, the concrete shall be maintained at a temperature of at least 50F for five days or 70F for three days after placement. Concrete and adjacent form surfaces shall be kept continuously moist. Sudden cooling of concrete shall not be permitted.

#### 3.4 FINISHING



- 3.4.1 All exposed surfaces shall be given a steel float finish unless noted otherwise.
- 3.4.2 Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which caused a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working of the surface.
- 3.4.3 Initial floating shall be followed by a second floating at the time of initial set. The second floating shall produce a finish of uniform texture and color. Unless additional finishing is specifically required, the completed finish for unformed surfaces shall be the float finish produced by the second floating. All holes, voids or irregularities shall be filled.
- 3.4.4 Floating shall be performed with hand floats or suitable mechanical compactor floats.

### 3.5 TESTING

- 3.5.1 Field control tests, consisting of slump tests and making compression test cylinders, shall be performed by qualified personnel in the presence of the Owner. The Contractor shall provide all equipment and supplies and the services of one or more employees as necessary for the field control testing.
- 3.5.2 All testing required for preliminary review shall be made by an acceptable independent testing laboratory at the expense of the Contractor. Field control cylinders made during the progress of the work will be compression tested at the expense of the Contractor.
- 3.5.3 The frequency hereinafter specified for each field control test is a minimum. If additional field control tests are necessary, in the opinion of the Owner, all such tests shall be made in accordance with the limits prescribed in Section 01 45 29.

END OF SECTION

## SECTION 03 35 36 - CONCRETE FINISHING(SITEWORK)

### 1.0 GENERAL

#### 1.1 DESCRIPTION

1.1.1 Work included: provide finishes on cast-in-place concrete as called for on the drawings, specified herein, and needed for a complete and proper installation. Confirm all finishes with Owner's Representative prior to construction.

1.1.2 Related Work:  
Division 03 30 53: Cast-in-Place Concrete.

#### 1.2 QUALITY ASSURANCE

Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.

#### 1.3 SUBMITTALS

1.3.1 Comply with provisions of General Conditions.

1.3.2 Product data: After the Contractor has received the Owner's Notice of Award, submit:

- A. Materials list of items proposed to be provided under this division.
- B. Manufacturer's recommended installation procedures which, when approved by the Owner's Representative, will become the basis for accepting or rejecting actual installation procedures used on the work.

### 2.0 PRODUCTS

#### 2.1 MATERIALS

Carefully study the drawings and these Specifications, and determine the location, extent, and type of required concrete finishes.

### 3.0 EXECUTION

#### 3.1 SURFACE CONDITIONS

Examine the areas and conditions under which work of this Division will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until conditions are correct.

#### 3.2 FINISHING

Definition of Finishing Tolerances:

A. Exterior Flatwork: "Class B per ACI 347": True plane within 1/4" in five feet as determined by a five foot straightedge placed anywhere on the slab in any direction.

Site retaining walls: "Class A per ACI 347". True plane within 1/8" in five feet as determined by a five foot straightedge placed anywhere on the wall in any

direction.

- B. Unless otherwise directed by the Owner's Representative, provide the texturing in one direction only.
- C. Exterior Flatwork: Provide "medium" coarse broom texturing as directed by the Owner's Representative or otherwise called for on the drawings. Fill and patch all honeycomb, spalls, tie holes, etc. rub surface with carborundum brick.

Site retaining walls: Fill and patch all honeycomb, spalls, tie holes, etc. rub surface with carborundum brick. Surfaces exposed to view shall be rubbed or otherwise coated with a grout plaster to provide a uniform finish adequately bonded to the structure.

### 3.3 CURING AND PROTECTION

3.3.1 Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures, and mechanical injury.

3.3.2 Temperature, Wind, and Humidity:

- A. Cold Weather:
  - (1) When the mean daily temperature outdoors is less than 40 degrees F, maintain the temperature of the concrete between 50 degrees F and 70 degrees F for the required curing period;
  - (2) When necessary, provide proper and adequate heating system capable of maintaining the required heat without injury due to concentration of heat;
  - (3) Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.
- B. Hot weather: When necessary, provide wind breaks, fog spraying, shading, sprinkling, ponding, or wet covering with a light colored material, applying as quickly as concrete hardening and finishing operations will allow.
- C. Rate of temperature change: Keep the temperature of the air immediately adjacent to the concrete during and immediately following the curing period as uniform as possible and not exceeding a change of 5 degrees F in any one hour period, or 50 degrees F in any 24 hour period.

3.3.3 Protection from Mechanical Injury:

- A. During the curing period, protect the concrete from damaging mechanical disturbances such as heavy shock, load stresses, and excessive vibration.
- B. Protect finished concrete surfaces from damage from construction equipment, materials, and methods, by application of curing procedures, and by rain and running water.
- C. Do not load self-supporting structures in such a way as to over stress the concrete.

END OF SECTION

## SECTION 03 4500

### ARCHITECTURAL PRECAST CONCRETE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Plant precast reinforced architectural concrete units and supplementary items necessary for installation.
  - 1. Architectural precast concrete cladding units.

##### 1.2 DELEGATED ENGINEERING REQUIREMENTS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.
- B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
- C. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- D. Coordination of Work:
  - 1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
  - 2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer/fabricator's technical literature for each product and system indicated.
  - 1. Include manufacturer/fabricator's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Design Mixtures: Manufacturer/fabricator's detailed ingredients list for each concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Indicate details at building corners.
  - 1. Indicate separate face and backup mixture locations and thicknesses.
  - 2. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
  - 3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
  - 4. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
  - 5. Indicate relationship of units to adjacent materials.
  - 6. Indicate joints, reveals, and extent and location of each surface finish.
  - 7. Thin Masonry Facing Units: Indicate locations and details of thin masonry facing units, including corner units, special shapes, and joint treatments.
  - 8. Stone Facing Units: Indicate locations and details of stone facing units, anchors, and joint treatments.
  - 9. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Concrete-Faced Unit Samples for Verification Purposes: Exposed surfaces of concrete-faced units for each type of finish indicated, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 in by 12 in by 2 in (300 mm by 300 mm by 50 mm).
- E. Thin Masonry Facing Unit Samples for Verification Purposes: Exposed surfaces of masonry-faced units for each type of finish indicated, in sets of 3, illustrating full range of color and texture variations expected; approximately 12 in by 12 in by 2 in (300 mm by 300 mm by 50 mm).
- F. Stone Facing Unit Samples for Verification Purposes: Exposed surfaces of stone-faced units for each type of finish indicated, in sets of 3, illustrating full range of color and texture variations expected; approximately 12 in by 12 in by 2 in (300 mm by 300 mm by 50 mm).

### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding Certifications: Qualification certificates required by "Quality Assurance" Article. Include names of firms and personnel certified.
- B. Material Certificates: For the following items, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Reinforcing materials.
  - 3. Admixtures.
  - 4. Bearing pads.

5. Structural-steel shapes and hollow structural sections.
  6. Thin Masonry Facing Units: Brick units and accessories.
  7. Stone Facing Units: Stone anchors.
- C. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- D. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
1. Results that materials, including water, in concrete mix are free of ferrous or other material which will cause surface staining during curing operations or upon exposure to weather.
  2. Results that aggregates have a stain index of less than 20 according to ASTM C 641.
- E. Source Quality Control Test Reports: Reports from fabricator required by "Source Quality Control" Article.
- F. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control" Article.
- G. Qualification Data:
1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
  2. Submit verification that manufacturer/fabricator is a participant in one of the required certification programs as specified.

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
1. Certification Program Participant: Participates in one of following:
    - a. PCI's plant certification program and designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units.
    - b. APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and designated an APA-certified plant.
- B. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  3. Manufacturer/Fabricator Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer/fabricator to install products.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

- D. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- F. Welding: Qualify procedures and personnel according to AWS qualification requirements and following:
1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel".
  2. AWS D1.4, "Structural Welding Code - Reinforcing Steel".
- G. Pre-Production Sample Units: After sample acceptance and before fabricating architectural precast concrete units, produce sample units for review by Architect. Provide as many sample units as required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Use materials and installation methods indicated for the completed Work.
1. Produce a minimum of 2 field sample units approximately 16 sq ft (1.5 sq m) in area for review. Incorporate full-scale details of architectural features, finishes, textures, reveals, and transitions in sample units.
  2. Locate field sample units at site in locations indicated or, if not indicated, as directed by Architect.
  3. Damage part of an exposed-face surface for each finish, color, and texture and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
  4. After acceptance of repair technique, maintain one field sample unit at fabricator's plant and one at site in an undisturbed condition as a standard for judging the completed Work.
  5. Demolish and remove field sample units when directed by Architect.
- H. Range Sample Units: After pre-production sample unit acceptance and before fabricating units, produce a minimum of 3 sets of range samples, approximately 6 sq ft (1.5 sq m) in area, representing anticipated range of each color and texture on Project's units. After acceptance of range samples, retain one set of range samples at site and send remaining range sample sets to manufacturer/fabricator's plant for color and texture approval reference.
- I. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  - 3. Record discussions, including decisions and agreements, and prepare report.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Preparation for Shipping: Apply water repellent to units as specified in "Fabrication" Article in this Section before transporting them to the Project.
- B. Delivery: Deliver units in such quantities and at such times to limit unloading units temporarily on ground. Support units during shipment on nonstaining shock-absorbing material.
- C. Storage: Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping, or other physical damage.
- D. Handling: Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses which would cause cracking or damage. Lift and support units only at designated points shown on Shop Drawings.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **1.9 SEQUENCING**

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.



## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer/fabricator. Provide secondary materials only as recommended by manufacturer/fabricator of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Design Loads: Engineer to withstand design loads including but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable local building codes and as indicated.
  - 1. Structural Movement: Engineer to withstand movements of structure including, but not limited to, drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads. Contractor shall obtain required design data and identify movements accommodated on submittal drawings.
    - a. Accommodate plus or minus 3/8 in (10 mm) differential vertical deflection of floors.
- C. Thermal Movements: Engineer products and systems to accommodate thermal movements of supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses, damaging loads on fasteners, failure of operating units to function properly, and other detrimental effects.
  - 1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.
- D. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.
- E. Building Maintenance Equipment: Engineer units supporting building maintenance equipment to resist pull-out and horizontal shear forces transmitted from equipment.

### **2.4 MOLD MATERIALS**

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; non-reactive with concrete and suitable for producing required finishes.
- B. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent surface or joint treatments of concrete.

- C. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer/fabricator's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface or joint treatments of concrete.

## **2.5 REINFORCING MATERIALS**

- A. Reinforcing Bars: One of both of the following as required:
  - 1. Reinforcing Bars: ASTM A 615 / A 615M, Grade 60 (Grade 420), deformed.
  - 2. Low-Alloy-Steel Reinforcing Bars: ASTM A 706 / A 706M, deformed.
- B. Steel Bar Mats: ASTM A 184 / A 184M, fabricated from ASTM A 615 / A 615M, Grade 60 (Grade 420) or ASTM A 706 / A 706M, deformed bars, assembled with clips.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn or galvanized steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497 / A 497M, flat sheet.
- E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

## **2.6 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C 150, Type I or Type III, gray for non-exposed backup concrete, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure, mix gray, white, tan, or a combination to produce exposed finish color selected, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials: Not to be used in face mixture; allowed in back of unit mixture only
  - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
  - 2. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
  - 3. Metakaolin Admixture: ASTM C 618, Class N.
  - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
  - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining. Uniformly or gap graded to match approved sample.
  - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, non-fading, and alkali resistant.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer/fabricator to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer/fabricator to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

## **2.7 STEEL CONNECTION MATERIALS**

- A. Carbon-Steel Shapes and Plates: ASTM A 36 / A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
- C. Carbon-Steel Plate: ASTM A 283 / A 283M.
- D. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- E. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- F. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- G. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A / ASTM F 568M, Property Class 4.6; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 / A 563M; and flat, unhardened steel washers, ASTM F 844.
- H. Zinc-Coated Finish: For steel items and connections exposed to exterior and unconditioned areas, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.
  - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
  - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
- I. Shop-Primed Finish: For steel items and connections exposed to interior and conditioned areas, prepare surfaces of non-galvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 or SSPC-Paint 25 according to SSPC-PA 1.
- J. Welding Electrodes: Comply with AWS standards.
- K. Accessories: Cast-in structural steel anchors, inserts, plates, angles, clips, hangers, shims, bearing pads, and other similar accessories required to install units.

## **2.8 GROUT MATERIALS**

- A. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107 of consistency suitable for application within a 30-minute working time.

## 2.9 GUTTER DRAINAGE SYSTEM

- A. Gutter drainage system at back of units may be either prefabricated silicone system or fabricated galvanized sheet steel system as indicated on the Drawings.
- B. Prefabricated Silicone Gutter Drainage System: Flame-resistant extruded silicone collection channel system used to collect moisture or condensation on the back side of the units. Include accessories such as end dams, weep baffles and silicone weeps as necessary to drain collected moisture to the exterior of the building.
  - 1. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include but are not limited to those listed below:
    - a. Basis of Design: 2DS; "Secondary Drainage Systems - Precast".
- C. Fabricated Galvanized Sheet Steel Gutter Drainage System: Galvanized sheet steel collection channel system used to collect moisture or condensation on the back side of the units. Include accessories such as end dams, weep baffles, and silicone weeps as necessary to drain collected moisture to the exterior of the building.
  - 1. Zinc-Coated (Galvanized) Sheet Steel: ASTM A 653, G90 coating designation; structural quality, not less than 0.0312 in (0.79 mm) (20 gage) unless otherwise indicated.
  - 2. Solder for Galvanized Sheet Steel: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.
  - 3. Fabricate gutter drainage system to cross section indicated with clips and accessories required for secure watertight installation. Meet recommendations of SMACNA for fabrication details and metal thicknesses.
- D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
- E. Joint Sealant: Silicone construction sealant as specified in Division 07 Section "Joint Sealants".

## 2.10 CONCRETE MIXTURES

- A. Mix Designs: Prepare design mixtures for each type of precast concrete required.
  - 1. Limit use of fly ash and silica fume to 20 percent of Portland cement by weight; limit metakaolin and silica fume to 10 percent of Portland cement by weight. Not allowed in face of unit mix.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength: 5000 psi (34.5 MPa) minimum at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.

- E. Water Absorption: 6 percent by weight or 14 percent by volume according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

## **2.11 MOLD FABRICATION**

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
  - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - 1. Form joints are not permitted on faces exposed to view in the finished Work.
  - 2. Edges and corners shall be uniformly chamfered or radius as indicated on the Drawings.

## **2.12 FABRICATION**

- A. Fabrication Quality Standards: In addition to standards listed elsewhere, comply with following, unless otherwise specified in this Section:
  - 1. PCI MNL 117.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. General: Fabricate units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with fabrication quality standard, product tolerances, and position tolerances for cast-in items.
- C. Connection Hardware:
  - 1. Fabricate cast-in anchors, inserts, plates, angles, and other anchorage hardware with sufficient anchorage and embedment to comply with delegated engineering.
  - 2. Accurately position for attachment of loose hardware, and secure in place during precasting operations.
  - 3. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 4. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- D. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete.
- E. Cast-in openings larger than 10 in (250 mm) in any dimension. Do not drill or cut openings without Architect's approval.

- F. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement:
1. Clean reinforcement of loose rust and mill scale and other materials that reduce or destroy bond with concrete.
  2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
  3. Place reinforcement to maintain at least 3/4 in (19 mm) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
  4. Place reinforcing steel to maintain at least 3/4 in (19 mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 in (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
  5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by delegated engineering. Offset laps of adjoining widths to prevent continuous laps in either direction.
- G. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- H. Placing Concrete:
1. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
  2. Place face mixture to a minimum thickness after consolidation of greater of 1 in (25 mm) or 1.5 times maximum aggregate size, but not less than minimum reinforcing cover specified.
  3. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in units.
  4. Place backup concrete mixture to ensure bond with face-mixture concrete.
  5. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
- I. Hot and Cold Weather Concrete Placement: Comply with PCI MNL or ACI 306.1 procedures for cold weather concrete placement and ACI 305R recommendations for hot weather concrete placement.
- J. Handling Units: Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- K. Curing: Cure concrete, according to PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.
- L. Defective Units: Discard and replace units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's and Owner's approval.

- M. Preparation for Shipping: Prior to transporting units to the Project site, apply coating of water repellent to units as recommended by manufacturer/fabricator to protect unit surfaces from staining or moisture damage which may occur during transport. Water repellent shall not permanently change the appearance of the units from the approved field samples.

### **2.13 FABRICATION TOLERANCES**

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.
- B. Brick-Faced Architectural Precast Concrete Units: Restrict the following misalignments to 2 percent of number of bricks in a unit.
1. Alignment of Mortar Joints:
    - a. Jog in Alignment: 1/8 in (3 mm).
    - b. Alignment with Panel Centerline: Plus or minus 1/8 in (3 mm).
  2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 in (3 mm).
  3. Tipping of Individual Bricks from the Panel Plane of Exposed Brick Surface: Plus 1/16 in (1.5 mm); minus 1/4 in (6 mm) less than or equal to depth of form liner joint.
  4. Exposed Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 in (6 mm); minus 1/8 in (3 mm).
  5. Individual Brick Step in Face from Panel Plane of Exposed Brick Surface: Plus 1/16 in (1.5 mm); minus 1/4 in (6 mm) less than or equal to depth of form liner joint.
- C. Stone Veneer-Faced (Smooth Finish) Architectural Precast Concrete Units.
1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus 1/4 in (6 mm).
  2. Variation in Joint Width: 1/8 in in 36 in (3 mm in 900 mm) or a quarter of nominal joint width, whichever is less.
  3. Variation in Plane between Adjacent Stone Units (Lipping): 1/16 in (1.5 mm) difference between planes of adjacent units.

### **2.14 CONCRETE-FACED UNIT FINISHES**

- A. Unit Finish: Unit faces shall be free of joint marks, grain, and other obvious defects. Corners, chamfers, and including false joints shall be uniform, straight, and sharp.
- B. Exposed Face Surfaces: As scheduled or as indicated in Design Selections; match approved sample units for aesthetic purposes.
- C. Exposed Top, Bottom, and Sides Surfaces: Match exposed face surface finish.
- D. Exposed Back Surfaces: Smooth, steel-trowel finish.
- E. Unexposed Surfaces: Float finish.

### **2.15 SOURCE QUALITY CONTROL**

- A. Quality-Control Testing: Test and inspect units according to PCI MNL 117 requirements.
- B. Owner may employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- C. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.
- D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
  2. Cores will be tested in an air-dry condition.
  3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
  4. Test results will be made in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:
    - a. Project identification name and number.
    - b. Date when tests were performed.
    - c. Name of precast concrete fabricator.
    - d. Name of concrete testing agency.
    - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Work: Units not complying with requirements, including strength, manufacturing tolerances, and finishes, are defective. Replace with units that comply with requirements.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Acceptance of Building Structural Frame: Do not install units until supporting cast-in-place concrete building structural framing has attained minimum allowable design compressive strength, supporting structural steel framing, or other structure is complete.



### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. PCI MNL 127.
  2. Respective manufacturer/fabricator's written installation instructions.
  3. Accepted submittals.
  4. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer/fabricator's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF ARCHITECTURAL PRECAST CONCRETE**

- A. Erection: Install units level, plumb, in alignment, and square within specified allowable tolerances.
1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
  2. Remove projecting lifting devices and use sand-cement grout to fill voids within recessed lifting devices flush with surface of concrete.
  3. Unless otherwise indicated, maintain uniform joint widths of 3/4 in (19 mm).
- B. Attachments, General: Connect units in position by bolting, welding, or grouting.
- C. Bolted Connections: Use lock washers, lock nuts, or other acceptable means to prevent loosening of bolted connections.
- D. Welding: Perform welding in compliance with AWS D1.1/D1.1M and AWS D1.4 with qualified welders.
1. Protect units from damage by field welding or cutting operations, and provide noncombustible shields as required.
  2. Repair damaged galvanized steel surfaces by cleaning and applying a coat of galvanizing repair paint to galvanized surfaces.
  3. Repair prime painted steel by cleaning and re-priming damaged painted surfaces.
- E. Grouting Connections:
1. Grout connection block-outs after final adjustment.
  2. Retain grout in place until hard enough to support itself.
  3. Pack spaces with stiff grout material, tamping until voids are completely filled.
  4. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
  5. Keep grouted joints damp for not less than 24 hours after initial set.
  6. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

### **3.5 ERECTION TOLERANCES**

- A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

- B. Gutter Drainage System: Securely attach gutter drainage system to back of units using powder actuated fasteners as indicated on the Drawings. Seal joints with silicone joint sealant as specified in Division 07 Section "Joint Sealants". Slope system to positive drain to weeps.

### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency Field Service: The Owner may employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.
- B. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.7 REPAIRS**

- A. Procedures:
  - 1. Repair exposed surfaces of units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect and Owner. Architect and Owner reserves right to reject repaired units that do not comply with requirements.
  - 2. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired Work, when viewed in typical daylight illumination from a distance of 20 ft (6 m).
  - 3. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
  - 4. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
  - 5. Remove and replace damaged units if repairs do not comply with requirements.

### **3.8 CLEANING**

- A. Cleaning: After erection and completion of joint treatment, clean exposed surfaces of units to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to manufacturer/fabricator's written recommendations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

### **3.9 FINISH SCHEDULE:** Refer to Exterior Elevation drawings.

**END OF SECTION**



## SECTION 04 2100

### MASONRY VENEER

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Exterior, non-load bearing masonry veneer units and supplementary items necessary for installation.

##### 1.2 DEFINITIONS

- A. Masonry Veneer Terminology: Refer to BIA 2 and other referenced quality standards.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each type of product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
    - a. Kind, size, and color of masonry unit.
    - b. Manufactured accessory product.
    - c. Cleaning products, including application procedures.
- B. Shop Drawings: Show details of construction and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Including, but not limited to, the following:
  - 1. Masonry Veneer Units: Show sizes, profiles, and coursing.
  - 2. Special Masonry Veneer Shapes: Submit large-scale details for each shape required or indicated.
  - 3. Flashing: Large-scale details for each element of flashing system showing layout, profiles, methods of joining, and anchorage details; including lintel units, shelf units, corner units, end dam units, conditions showing interface and relationship to adjacent materials, and other special applications.
  - 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
  - 5. Anchors, Ties, and Accessories: Show sizes, coursing, and locations.
- C. Samples for Initial Selection: For each type of Masonry Veneer and Colored Mortar as indicated. Include samples of accessories involving color selection. Samples shall show full range of colors expected; make samples using same materials to be used on Project; label samples to indicate type and amount of pigments used.

- D. Samples for Verification Purposes: Submit samples for each item listed below of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.
1. Masonry Veneer: Full-size samples for each different unit indicated.
  2. Pigmented and Color Aggregate Mortar: Make samples using same sand and mortar ingredients to be used on Project; label samples to indicate type and amount of pigments used.
  3. Accessories: Samples of manufactured products, including anchors, ties, cavity drainage material, flashing materials, weeps, vents, and other accessories.
  4. Flashing: Samples of each shape, profile, intersection and transition required, not less than 12 in (300 mm) long, including end dam, and splice/lap joint for lintel and shelf angle flashing; demonstrate soldering quality.
- E. List of Materials Used in Constructing Wall Mock-ups:
1. Product, material, and equipment names, model numbers, lot numbers, batch numbers, source of supply, and other information required to identify items used. Include mix proportions for mortar and source of aggregates.
  2. Receipt of list does not constitute acceptance approval of deviations from Contract Documents, unless such deviations are specifically accepted approved by Architect in writing.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
1. Masonry Veneer Units: Material test reports substantiating compliance with specified requirements.
  2. Cementitious Materials: Each product required for mortar, including name of manufacturer, brand, type, and weight slips at time of delivery.
  3. Mortar Mixes: Certification of mortar mix design shall be based on evaluation of comprehensive tests performed. Include description of type and proportions of ingredients.
  4. Joint reinforcement: Each type and size of manufactured products.
  5. Anchors, Ties, and Accessories: Each type and size of manufactured products.
- B. Hot and Cold Weather Work Plan: Submit written plan detailing methods, materials and equipment to be used to comply with weather requirements.
- C. Masonry Veneer Cleaning Plan: Based on technical information provided by respective manufacturer for each masonry veneer unit to be cleaned, submit written plan for cleaning exposed masonry veneer surfaces, prepared by commercial cleaning compound manufacturer, with signature of installer indicating acceptance and include following information:
1. Qualifications of applicators.
  2. Products to be used and application procedures.
  3. Masonry veneer surfaces to be cleaned and required preparations.

4. Environmental requirements by authorities having jurisdiction for use and discharge of cleaning effluents.
  5. Protection of surrounding areas, landscaping, and building surfaces adjacent to area of cleaning.
- D. Field Quality Control Reports: Written report of testing and inspection required by Field Quality Control.
- E. Manufacturer Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- F. Qualification Data:
1. For firms and persons specified in Quality Assurance to demonstrate their capabilities and experience. Include list of completed projects.

### **1.5 QUALITY ASSURANCE**

- A. Quality Standards: In addition to specified requirements, comply with ACI 530.1/ASCE 6/TMS 602, and local building code, whichever is more stringent.
- B. Installer Qualifications:
1. Experience: Installer personnel with not less than 10 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 10 years of experience installing products and systems similar to scope of this Project.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated.
- D. Pre-Construction Mortar Testing: Owner will employ and pay an independent testing agency to perform pre-construction testing to establish compliance of proposed Work with specified requirements.
1. General Requirements: Test mortar for composition to establish standard for field testing specified under "Field Quality Control" Article.
  2. Test Method: ASTM C 780, Annex A4.
  3. Specimen Quantity: Provide required number of mortar samples.
  4. Reports: Interpret test results and prepare certified reports.
  5. Equivalent Option to Testing: Testing will not be required if manufacturer's data is based on testing done within previous two years.
  6. Retesting: Retesting of materials failing to meet specified requirements shall at Contractor's expense.

- E. Sample Panels: Prior to installing masonry, build as many sample panels as required to verify selections made under submittals and to demonstrate aesthetic effects using specified materials:
1. Build approximately 48 in (1200 mm) square for each type of exposed masonry units.
  2. Locate at locations indicated or, if not indicated, as directed by Architect.
  3. Clean exposed faces with masonry cleaner specified.
  4. Where masonry is to match existing masonry, erect panels adjacent and parallel to an existing, south-facing wall.
  5. Notify Architect 7 days in advance of the dates and times when panels will be constructed.
  6. Protect accepted approved sample panels with weather-resistant membrane.
  7. Maintain during construction in an undisturbed condition as a standard for judging completed Work.
  8. Acceptance Approval of panels is for following aesthetic qualities; acceptance approval does not constitute acceptance approval of deviations from Contract Documents, unless specifically accepted approved by Architect in writing:
    - a. Color, texture, and blending of masonry units.
    - b. Color and blending of mortar.
    - c. Relationship of mortar and sealant colors to masonry unit colors.
    - d. Tooling of joints.
    - e. Effectiveness of masonry cleaner.
    - f. Other aesthetic qualities as determined by the Architect.
  9. When directed, demolish and remove mock-up from Project site, including foundations.
- F. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## 1.6 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:
  - a. Architect.
  - b. Contractor, including superintendent.
  - c. Installer, including project manager and supervisor.
  - d. If requested, Manufacturer's qualified technical representative.
  - e. Installers of other construction interfaced with Work.
  
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
  - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  
3. Record discussions, including decisions and agreements, and prepare report.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Label pallets of masonry veneer units with manufacturers name, product name, and information required to identify products.
  
- B. Storage:
  1. Masonry Veneer Units: Store 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.
  2. Cementitious Materials: Store on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
  3. Aggregates: Store where grading and other required characteristics can be maintained and contamination avoided.
  4. Accessories: Store to prevent corrosion and accumulation of dirt and oil.

#### **1.8 PROJECT CONDITIONS**

- A. Protection during Work: Prevent excess moisture from entering Work in progress.
  1. Cover tops of walls, projections, and sills with water-repellent tarps or heavy plastic sheets at end of each day's Work.
  2. Cover partially completed masonry veneer when construction is not in progress.
  3. Extend cover minimum of 24 in (600 mm) down both sides and hold cover securely in place.



4. Protect door and window frames from damage.
- B. Stain Prevention: Prevent mortar and soil from staining exposed masonry veneer. Immediately remove mortar and soil from exposed masonry veneer.
1. Protect base of walls from rain-splashed mud and mortar splatter.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, and other adjacent with painted and integral finishes from mortar droppings.
  4. Turn scaffolding planks near Work on edge at end of each day to prevent rain from splashing mortar droppings or dirt onto face of exposed masonry veneer.
- C. Cold Weather Requirements: Comply with building code or TMS 602/ACI 530.1/ASCE 6 whichever is more stringent, and the following:
1. Do not apply when ambient temperature is less than 32 deg F (0 deg C) or when 40 deg F (4.4 deg C) or less and falling.
  2. Provide heat and protection (temporary or permanent) as required to protect Work from freezing for not less than 48 hours after application.
  3. Distribute heat uniformly to prevent concentration of heat near sources; provide deflection or protective screens.
  4. Do not use frozen materials or materials mixed or coated with ice or frost.
  5. Do not build on frozen substrates.
  6. Remove and replace masonry veneer damaged by frost or freezing conditions.
  7. Use liquid cleaning methods only when air temperature is 40 deg F (4.4 deg C) and above and will remain so until masonry veneer has dried, but not less than 7 days after completing cleaning.
- D. Warm Weather Requirements: Comply with building code or TMS 602/ACI 530.1/ASCE 6 whichever is more stringent, and the following:
1. Protect Work against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.
  2. Apply and cure work as required by climatic and job conditions to prevent dryout during cure period.
  3. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

## 1.9 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section Substitution Procedures.
- B. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
- C. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Masonry Units: Obtain exposed masonry veneer units of a uniform texture and color, or a uniform blend within ranges accepted for these characteristics.
- C. Cementitious Materials: Obtain cementitious ingredients of a uniform quality, including color, for each component.

### **2.3 MASONRY UNITS, GENERAL**

- A. Defective Units: Referenced standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in standard. Do not install units where defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in completed Work or will impair quality of completed masonry veneer.
- B. Match Existing Masonry Veneer: Wherever "match existing" indicated, provide masonry veneer unit of matching color, texture, and size as existing adjacent masonry veneer work.

### **2.4 FACE BRICK MASONRY UNITS**

- A. Product Quality Standard: ASTM C 216 or ASTM C 652, Grade SW, Type FBS.
  - 1. Unit Compressive Strength: Minimum 3000 psi (20.7 MPa) for average of 5 bricks, and 2500 psi (17.2 MPa) for individual brick, gross area, according to ASTM C 67, Section 7.
  - 2. Hot and Cold Water Testing:

- a. Water Absorption: Maximum 17.0 percent for average of 5 bricks, and 20.0 percent for individual brick, according to ASTM C 67, Section 8 for 5 hour boiling test.
  - b. Saturation Coefficient: Maximum 0.78 for average of 5 brick, and 0.80 for individual brick.
  - c. Requirement Waivers:
    - 1) Absorption: Saturation coefficient requirement may be waived if there is maximum 8.0 percent absorption of random sampling of 5 bricks according to ASTM C 67, Section 8 for 24 hour submersion test.
    - 2) Freezing and Thawing: Water absorption and saturation coefficient requirements may both be waived if there is maximum 0.5 percent loss in dry weight of any individual brick according to ASTM C 67, Section 9, for 50 cycles of freezing and thawing.
  3. Initial Rate of Absorption: Between 5 and 25 g/m per 30 sq in (0.02 sq m) according to ASTM C 67, Section 10. Use of coating to establish initial rate of absorption is not permitted and will not be allowed.
  4. Efflorescence: Rated "not effloresced" according to ASTM C 67, Section 11.
  5. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing according to ASTM C 67, Section 8, with no observable difference in applied finish when viewed from 10 ft (3 m) under an minimum illumination of 50 foot-candles (538 lumen/square meter).
- B. Basis of Design: As scheduled or as indicated in Design Selections.

## **2.5 CALCIUM SILICATE MASONRY UNITS**

- A. Product Quality Standard: ASTM C 73, Grade SW.
1. Compressive Strength: Minimum 6600 psi (45.5 MPa) according to ASTM C 170.
  2. Absorption: Maximum 8.8 percent according to ASTM C 97.
  3. Density: Minimum 129 pcf (2066 kg/cu m) according to ASTM C 97.
  4. Modulus of Rupture: Minimum 770 psi (5.3 MPa) according to ASTM C 99.
  5. Freeze-Thaw Durability: No observable distress.
- B. Basis of Design: As scheduled or as indicated in Design Selections.

## **2.6 DECORATIVE CONCRETE MASONRY UNITS**

- A. Product Quality Standard: ASTM C 90.
1. Unit Compressive Strength: Minimum average net area compressive strength of 1900 psi (13.1 MPa) for 3 units, and minimum 1700 psi (11.7 MPa) for individual unit.
  2. Weight Classification: Medium weight.
- B. Integral Water Repellent: Provide units made with integral water repellent.

1. Description: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on back of test specimen.
  2. Manufacturers and Products:
    - a. Addiment Inc.; Block Plus W-10.
    - b. Grace Construction Products; Dry-Block.
- C. Basis of Design: As scheduled or as indicated in Design Selections.

## **2.7 SHELF ANGLES AND LINTELS**

- A. Steel Angle Lintels: Materials complying with Division 05 Section Metal Fabrications for loose masonry lintels (Designation MF), with schedule as shown on the Drawings.

## **2.8 MORTAR MATERIALS**

- A. Portland Cement:

1. Material Quality Standard: ASTM C 150, Type I; except Type III may be used for cold-weather construction.
2. Color: Natural gray color or white cement as required to produce mortar color required.
3. Manufacturers:
  - a. LafargeHolcim.
  - b. Lehigh Cement Co.
  - c. Lone Star Industries, Inc.
  - d. Rinker Materials.
  - e. Royal White Cement.
4. Types of Cements Not permitted:
  - a. Masonry Cement: ASTM C 91.
  - b. Mortar Cement: ASTM C 1329.

- B. Hydrated Lime:

1. Material Quality Standard: ASTM C 207, Type S.
2. Manufacturers:
  - a. Graymont Dolime (OH) Inc.
  - b. Rockwell Lime Co.

- C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.

1. Product Quality Standard: ASTM C 144.

2. Mortar Exposed to View: Use washed aggregate consisting of natural sand or crushed stone.
  3. Joints Less Than **1/4 in (6 mm)** Thick: Use aggregate graded with 100 percent passing No. 16 sieve.
- D. Aggregate for White Mortar: Natural white sand or ground white stone, as required to match approved sample.
- E. Aggregate for Colored Mortar: Natural sand or ground marble, granite, or other sound stone, as required to match approved sample.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Quantity Limitations: Pigments shall not exceed 10 percent of Portland cement by weight for mineral oxides or 2 percent for carbon black.
  2. Manufacturers and Products:
    - a. Bayer Corp., Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
    - b. Davis Colors; True Tone Mortar Colors.
    - c. Solomon Grind-Chem Service, Inc.; SGS Mortar Colors.
- G. Colored Portland Cement-Lime Mix: Packaged blend made from Portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Quantity Limitations: Pigments shall not exceed 10 percent of Portland cement by weight or 2 percent for carbon black.
  2. Manufacturers and Products:
    - a. Capital Materials Corp.; Riverton Portland Cement Lime Custom Color.
    - b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
    - c. LafargeHolcim; Eaglebond.
    - d. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
- H. Water: Potable, clean and free of amounts of oils, acids, alkalies, salts, organic materials, or other substances that are deleterious to mortar or any metal within the wall.

## **2.9 REINFORCEMENT**

- A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

## **2.10 VENEER ANCHORS AND TIES**

- A. General: For attaching masonry veneer to a back-up structure, use two-piece assemblies that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall; suitable for attachment conditions indicated.

1. Corrugated ties are not permitted.
- B. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 in (1.3 mm).
- C. Materials for Adjustable Masonry Veneer Anchors: Use one of the following. Mill-galvanized ties are not permitted.
1. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82 / A 82M with ASTM A 153 / A 153M, Class B-2 coating.
  2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008 / A 1008M, commercial sheet, hot-dip galvanized after fabrication to comply with ASTM A 153 / A 153M, Class B coating.
  3. Stainless Steel Wire: ASTM A 580 / A 580M, AISI Type 304.
- D. Adjustable Anchors for Connecting to Concrete, CMU or Structural Steel:
1. Description: Two-piece adjustable veneer anchoring system.
    - a. Anchors: Zinc alloy barrel, flanged head, screw and eye, with drilling threads suitable for structural substrate.
    - b. Ties: Hot-dip galvanized, carbon-steel wire, 3/16 in (5 mm) pre-coated diameter, triangular shaped ties, size as required to provide maximum bond, not less than 2 in (50 mm).
  2. Basis of Design: Heckmann Building Products, Inc.; POS-I-TIE Masonry Veneer Anchor System.
- E. Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls with Rigid Insulation in Cavity:
1. Anchor Plate: Minimum 0.0713 in (14 gage) (1.81 mm) uncoated base metal thickness, with projecting horizontal tabs of length to allow for insulation thickness, with holes or slots to receive pintel legs, with two screw holes; with rubberized asphalt flexible flashing material either adhered to back of plate, or loose for separate mounting.
  2. Wire Pintel: Minimum 3/16 in (5 mm) diameter, bent into open-end rectangle box shaped tie with 2 legs bent down to slip into anchor slot; length as required to extend at least halfway through masonry veneer but with minimum 5/8 in (15 mm) cover on outside face of masonry veneer.
  3. Manufacturers and Products:
    - a. Hohmann & Barnard, Inc.; HB-213-2X anchor plate and wire pintel.
    - b. Wire-Bond; RJ-711 (2401 anchor plate and 2402 wire pintel).
- F. Polymer-Coated Steel Drill Screws for Steel Studs:
1. Material Quality Standard: ASTM C 954.

2. Description: Self-drilling, hex washer head with bonded EPDM washer, screw of size and length required to penetrate steel stud flange by not less than 3 exposed threads; corrosion protective organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
3. Manufacturers and Products:
  - a. Elco Construction Products; Dril-Flex with Stalgard finish.
  - b. ITW Buildex; Teks Maxiseal with Climaseal finish.

## **2.11 MISCELLANEOUS ANCHORS**

- A. Dovetail Slots in Concrete for Shelf Angles: As specified in Division 03 Section Concrete Accessories unless indicated otherwise.

## **2.12 EMBEDDED FLASHING MATERIALS**

- A. Sheet Metal Flashing: Metal flashing to comply with SMACNA's Architectural Sheet Metal Manual and as follows:

1. Material:
  - a. Quality Standard: ASTM A 240 / A 240M or A 666, Type 304.
  - b. Description: Stainless steel, 2D annealed finish, not less than 0.0250 in (24 gage) (0.64 mm) thick, unless noted otherwise.
2. Solder:
  - a. Material Quality Standard: ASTM B 32, Grade Sn60.
  - b. Description: Solder with acid flux of type recommended by stainless steel sheet manufacturer; use a noncorrosive rosin flux over tinned surfaces.

- B. Sealant for Sheet Metal Flashing: Exterior non-sag silicone sealant, Class 100/50, as specified in Division 07 Section Joint Sealants.

- C. Rubberized-Asphalt Flexible Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 in (1.02 mm).

1. Manufacturers and Products:
  - a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
  - b. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
  - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
  - d. Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
  - e. Hohmann & Barnard, Inc.; Textroflash.
  - f. W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
  - g. Polyguard Products, Inc.; Polyguard 400.

2. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.13 ACCESSORIES

- A. Weeps and Vents: Provide one of the following:

1. Plastic Weep and Vent:

- a. Description: One-piece flexible extrusion made from ultraviolet light resistant polypropylene copolymer, consisting of honeycomb matrix of multiple cells, designed to fill head joint with outside face held back **1/8 in (3 mm)** from exterior face of masonry veneer.
- b. Color: As selected by Architect from manufacturer's standard colors available.
- c. Manufacturers and Products:
  - 1) Advanced Building Products, Inc.; Mortar Maze Weep Vents.
  - 2) Heckmann Building Products, Inc.; No. 85 Cell Vent.
  - 3) Hohmann & Barnard, Inc.; QV - Quadro-Vent.
  - 4) Wire-Bond; Cell Vent

2. Mesh Weep and Vent:

- a. Description: Compressed, 200 denier polyester with 90 percent open mesh and bonded with flame retardant adhesive.
- b. Color: As selected by Architect from manufacturer's standard colors available.
- c. Basis of Design: Mortar Net USA, Ltd.; Mortar Net Weep Vents.

- B. Cavity Drainage Material:

1. Description: Composed of either reticulated, nonabsorbent mesh made from polyethylene strands, or, polymer core geomatrix composed of woven nylon strands, molded and shaped in open weave configuration to maintain drainage at weeps without being clogged by mortar droppings, size as required to extend across entire width of cavity.
2. Manufacturers and Products:
  - a. Advanced Building Products, Inc.; Mortar Break II.
  - b. Heckmann Building Products, Inc.; No. 84 Weep-Thru Mortar Deflector.
  - c. Mortar Net USA, Ltd.; Mortar Net.
  - d. Polyguard Products, Inc.; Termi-Net.
  - e. Wire-Bond; Cavity Net II.

- C. Bond Breaker Strips:



1. Material Quality Standard: ASTM D 226, Type I.
  2. Description: Asphalt-saturated organic roofing felt (No. 15 asphalt felt).
- D. Termination Bars: ASTM A 666, Type 304 formed stainless steel flat bars; 1 in by 1/8 in (25 mm by 3 mm) thick; predrilled at 8 in (200 mm) centers. No aluminum or plastic bars allowed.
1. Anchors: Same type screws as used to attach veneer wall ties.
- E. Cavity Wall Insulation: As specified in Division 07 Section Thermal Insulation.
- F. Barrier Sealing Tape: Air and water barrier sheet material laminated to adhesive coated rubberized asphalt or butyl. Refer to Division 07 Section Air and Water Barriers.
- G. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity provided by waterproofing manufacturer.
- H. Asphalt Mastic Dampproofing: Water-based, cold-applied, non-flammable, asphalt mastic emulsion with refined asphalt, non-asbestos mineral fibers, and clay fillers complying with ASTM D 1227, Type II, Class 1. Brush, roller, or trowel grade allowed. Include primer and accessories as required.

#### **2.14 MASONRY VENEER CLEANERS**

- A. Commercial Cleaning Compounds: Products as recommended and approved by masonry veneer and mortar manufacturers.
1. Description: Manufacturer formulated, general purpose cleaner for removing mortar stains, efflorescence, and other construction related stains from new masonry veneer surfaces, with following suitability requirements:
    - a. Suitable for masonry veneer units and mortar installed, without discoloring or damaging masonry veneer materials.
    - b. Suitable for conditions at project site, including, but not limited to, windows, doors, other exterior wall elements, and adjacent walks or landscaping.
  2. Manufacturers:
    - a. Diedrich Technologies, Inc.
    - b. EaCoChem.
    - c. Prosoco, Inc.
- B. Cleaning Restrictions: Following methods are not permitted nor will they be allowed:
1. Hydrochloric acid.
  2. Muratic acid.
  3. Pressurized water blasting.
  4. Abrasive blasting.

## **2.15 METAL FLASHING FABRICATION**

- A. Field Measurements: Where metal flashing is to fit, cope, or be tailored to other construction, check actual dimensions of other construction by accurate field measurements before fabrication of metal flashing.
- B. Fabrication Procedures: Fabricate continuous flashings in sections 8 ft (2.4 m) long minimum, but not exceeding 12 ft (3.6 m). Provide splice plates at joints of formed, smooth metal flashing.
  - 1. Shop form flashing on a bending brake.
  - 2. Shape, trim and hand seam on bench as far as practical with proper tools.
  - 3. Form exposed metal Work without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated.
  - 4. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
  - 5. Form materials to shape indicated with straight lines, sharp angles and smooth curves.
  - 6. Fold and hem exposed edges of flashings.
- C. Flashing Joinery: Fabricate interior and exterior corners, intersections, and complex flashing conditions in shop, rather than in field, with properly folded, constructed and continuous soldered joints. Field fabricated units are not permitted and will not be allowed.

## **2.16 MORTAR MIX**

- A. General: Mix cementitious materials in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency for minimum 3 minutes to 5 minutes; do not hand mix.
  - 1. Admixture Limitation: Do not use admixtures including air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, calcium chloride or other admixtures, unless otherwise indicated.
    - a. Decorative Concrete Masonry Units: Use water-repellent admixture in the mortar for decorative concrete masonry units only.
  - 2. Cementitious Limitation: Limit cementitious materials in mortar to Portland cement and lime.
  - 3. Ingredient Measurement: Measure in a one cubic foot batching box before mixing for component materials not pre-blended, prepackaged or containerized.
  - 4. Aggregate Moisture Content: Monitor moisture content of aggregates and exercise caution when mixing to avoid over or under-sanding of mortar.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project.
- C. Mortar Mix:
  - 1. Mix Quality Standard: ASTM C 270, Proportion Specification for Portland cement-lime mortars, Type N.

2. Mortar Color: Standard gray, unless indicated otherwise.
3. Match Existing Mortar: Wherever "match existing" indicated, provide masonry mortar of matching color and texture as existing adjacent masonry veneer work.
4. Basis of Design: As scheduled or as indicated in Design Selections.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Applicable portions of BIA Technical Notes on Brick Construction, if no other installation quality standard applies to condition.
  2. ACI 530.1/ASCE 6/TMS 602 and local building code.
  3. Respective manufacturer's written installation instructions.
  4. Accepted submittals.
  5. Contract Documents.

#### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

#### **3.4 INSTALLATION OF MASONRY VENEER**

- A. Installation Performance Requirements: Ensure masonry cavity is properly isolated from building interior to prevent water infiltration from infiltrating out of masonry cavity into other components of building such as window and door jambs and building interiors.
- B. Openings: Leave for equipment to be installed before completion of masonry veneer; after installation of equipment, complete masonry veneer to match construction immediately adjacent to opening.
- C. Cutting: 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, un-chipped edges. Install cut units with cut surfaces and, where possible, cut edges concealed.

- D. Blending of Masonry Veneer Units: 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. If color blending is a critical aspect of Work, manufacturer shall provide instructions for blending.
- E. Mortar Workability: Maintain by remixing or retempering; mortar with added color pigments shall not be re-tempered. Discard mortar that has begun to stiffen or is not used within 2.5 hours after initial mixing.
- F. Match Existing Masonry Veneer: Match coursing and bonding of existing masonry veneer.

### 3.5 SHELF ANGLES AND LINTELS

- A. Steel Shelf Angles: Erection as specified in Division 05 Section Metal Fabrications.
- B. Steel Loose Lintels: Set where indicated or required, with not less than 8 in (200 mm) of bearing at each jamb, unless otherwise indicated.

### 3.6 LAYING MASONRY VENEER WALLS

- A. General: Lay out walls in advance for accurate spacing of surface bond patterns, uniform joint thicknesses, accurate location of openings, movement-type joints, returns, and offsets. Avoid using of less than half-size units at corners, jambs, and where possible at other locations.
- B. Bond Patterns:
  - 1. Exposed Masonry Veneer: Match coursing of existing masonry, unless otherwise indicated.
  - 2. Exposed Masonry Veneer: One-half running bond or one-third running bond as indicated.
  - 3. Concealed Masonry Veneer: Lay units in a wythe in running bond or bonded by lapping not less than 2 in (50 mm) lap.
  - 4. Corners: Bond and interlock each course of each wythe. Do not use units with less than nominal 4 in (100 mm) horizontal face dimensions at corners or jambs.
  - 5. Mitered corners are not allowed.
- C. Stopping and Resuming Work: In each course, rack back one-half unit length for one-half running bond pattern or one-third unit for one-third running bond pattern; do not tooth. When resuming Work, clean masonry veneer surfaces that are to receive mortar, remove loose masonry veneer units and mortar.
- D. Built-In Work:
  - 1. As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry veneer around built-in items.
  - 2. Fill space between steel frames and masonry veneer solidly with mortar, unless otherwise indicated.

### 3.7 MORTAR BEDDING AND JOINTING

#### A. General Procedures:

1. Do not disturb previously laid units.
2. Spread mortar for bed joint only so far ahead of laying units that mortar will be plastic when units are laid.
3. Butter end of unit with ample mortar so that head joint is completely filled with mortar when placed.
4. Do not deeply furrow bed joints or slush head joints.
5. Avoid over-plumbing and pounding of corners and jambs to fit stretcher unit after setting in place. Where adjustments must be made after initial setting, remove mortar and replace with fresh mortar.
6. Rock closures into place with both head joints and closure space spread with ample mortar. Place against adjacent units so that both horizontal and vertical joints are completely filled.

#### B. Mortar Joint Thickness: Minimum **3/8 in (10 mm)** wide for head and bed joints.

#### C. Hollow Masonry Veneer Units: Lay with face shells fully bedded in mortar and with head joints of depth equal to bed joints; with entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

#### D. Solid Masonry Veneer Units: Lay with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and place into wall construction. Do not deeply furrow bed joints or slush head joints.

#### E. Joint Tooling: Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

1. Make mortar joints straight, clean, and uniform in thickness. Tool joints to produce dense surface well bonded to edges.
2. Joints which are not tight at time of tooling shall be raked out, pointed, and then tooled.
3. Tool when mortar is partially set but still sufficiently plastic to bond.
4. Use a tool which compacts mortar, pressing excess mortar out of joint rather than dragging it out.
5. Tool vertical joint first.

#### F. Stone and Cast-Stone Trim Units: Lay with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and place into wall construction. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with water.

1. Rake out mortar joints for pointing with sealant.
2. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Division 7 Section Joint Sealants.

### 3.8 MASONRY CAVITIES, WEEPS, AND VENTS

- A. Cavity Cleaning: Keep cavity clean of mortar droppings and other materials. Strike joints facing cavity flush.
- B. Mortar Protection: Install cavity drainage material at base of cavity to protect bottom of cavity from mortar droppings that would prevent weeps from draining infiltrated water.
- C. Cavity Wall Insulation: As specified in Division 07 Section Thermal Insulation. In addition, install continuous strip of rigid cavity insulation, minimum **3 in (75 mm)** wide, at edges of cavities adjacent to jamb of through-wall openings.
- D. Weeps: Install weeps at maximum **32 in (800 mm)** on centers in head joints of first course of masonry veneer immediately above embedded flashings.
- E. Vents: Install vents at maximum **32 in (800 mm)** on centers in head joints of topmost course of masonry veneer immediately below shelf angles, and at top of each continuous cavity.

### 3.9 ANCHORING MASONRY VENEER

- A. Adjustable Anchors for Connecting to Concrete, CMU or Structural Steel: Anchor masonry veneer to structural members where masonry veneer abuts or faces structural members to comply with following, with anchors embedded in masonry veneer joints and attached to structure:
  - 1. Unless otherwise indicated, provide an open space not less than 1 in (25 mm) in width between back of masonry veneer and structural member. Keep open space free of mortar or other rigid materials.
  - 2. Anchor masonry veneer to structural members with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors vertically and horizontally as required for coursing with one anchor for every 2 sq ft (1858 sq cm) of masonry veneer; stagger alternating anchors in each row.
  - 4. Modified Bituminous Sheet Membrane Substrate: Apply a coating of liquid membrane behind through-wall attachments that penetrate modified bituminous sheet membrane.
- B. Adjustable Masonry Veneer Anchors for Sheathed Steel Studs Walls: Anchor masonry veneer to sheathed steel studs with proper anchors.
  - 1. Unless otherwise indicated, provide an open space not less than 2 in (50 mm) in width between back of masonry veneer and face of sheathing.
  - 2. Keep open space free of mortar or other rigid materials.
  - 3. Locate anchor plate portion of wall tie to allow maximum vertical differential movement of tie up and down.
  - 4. Space anchors at 16 in (400 mm) on center vertically and 16 in (400 mm) on center horizontally as required for coursing.
  - 5. Install additional anchors within 12 in (300 mm) of openings and at maximum 8 in (200 mm) on center around perimeter.
  - 6. Attach each anchor through sheathing to steel studs with 2 metal fasteners each.

- a. Air and Water Barrier Sheet Good Substrate: Install a strip of barrier flashing tape behind through-wall attachments that penetrate air and water barrier.
7. Embed wall tie, in proper orientation, at least halfway through masonry veneer but with at least 5/8 in (15 mm) cover on outside face of masonry veneer.
8. Seismic Anchors and Ties: Install pencil rod continuous horizontally.
9. Stack Bond Anchors and Ties: Install pencil rod continuous horizontally.

### **3.10 EMBEDDED FLASHINGS**

- A. General: Drawings may not necessarily indicate or describe full extent of Work required for completion of embedded flashing.
- B. Reglets and Nailers: Install for flashing and other related construction where they are shown to be built into masonry.
- C. Scheduled Locations: In addition to conditions shown on Drawings, install embedded flashings within masonry cavity at following locations to direct downward flow of infiltrated water within cavity to exterior:
  1. Shelf angles with end dams at through-wall openings; and with lap joints.
  2. Lintels with end dams or laps.
  3. Jambs at through-wall openings, full height from sill to head.
  4. Other obstructions.
- D. Preparation: Substrate surfaces shall be smooth and free from projections that could puncture flashing.
- E. Flashing Installation:
  1. Install sheet metal flashing true to line and levels indicated; minimize quantity of lap joints by using longest units possible.
  2. Set shaped sheet metal units in proper locations with outside hemmed edges flush with building face location indicated; attach cavity side flanges to sheathed steel stud wall with screw fasteners driven into studs.
  3. At continuous shelf angles, terminate horizontal flashings at through-wall openings with properly folded and constructed sheet metal end dams with a depth equivalent to one masonry veneer course, with continuous soldered joints.
  4. At lintels, terminate horizontal flashings at end of lintel with properly folded and constructed sheet metal end dams with a depth equivalent to one masonry veneer course, with continuous soldered joints.
  5. At lap joints of horizontal flashings, form neat and aligned joints by interlocking splice plate within hemmed edge of sheet metal flashing profile; apply sealant and rubberized asphalt flashing as indicated to create water-resistant joint.
  6. Set shaped sheet metal units at jambs of through-wall openings and lap inside of end dams at horizontal flashings below; coordinate installation with rigid cavity insulation.
  7. Seal cavity edges of sheet metal flashings within masonry cavity to sheathing with continuous rubberized asphalt flashing.

- F. Examination and Repair: Immediately prior to laying masonry veneer, examine exposed surfaces of flashing and seal penetrations and damaged areas with rubberized asphalt flashing material before covering with masonry veneer.
- G. Asphalt Mastic Dampproofing Application: Apply continuous layer of product, without pinholes or holidays, at below grade masonry veneer locations and as indicated on drawings. Apply at coverage rate instructed by manufacturer.
  - 1. Repair voids and damage. Patch with additional layer of asphalt mastic dampproofing extending 6 in (150 mm) beyond repaired areas in all directions.

### **3.11 MASONRY VENEER EXPANSION JOINTS**

- A. General: Install masonry veneer expansion joints materials as Work progresses. Do not allow materials to span masonry veneer expansion joints without provision to allow for in-plane wall or partition movement. Maintain joints free and clear of mortar.
- B. Vertical Expansion Joints:
  - 1. Locate where indicated but not to exceed 26 ft (8 m) on center, and within 10 ft (3 m), 4 ft (1.22 m) preferred, of each side of outside corner. Keep vertical joints straight, true, and continuous from top to bottom of masonry veneer.
  - 2. Form open joint of width indicated for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants".
- C. Horizontal Joints: Build in horizontal pressure-relieving joints where indicated; construct of width required for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants". Locate not less than 3/8 in (9 mm) wide horizontal pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

### **3.12 INSTALLATION TOLERANCES**

- A. Conspicuous Lines:
  - 1. Vertical: For such conditions as external corners, door and window jambs, reveals, and masonry veneer expansion joints, maximum variation of the following from plumb:
    - a. 1/8 in (3 mm) in 10 ft (3 m).
    - b. 1/4 in (6 mm) in 20 ft (6 m).
    - c. 1/2 in (12 mm) overall.
  - 2. Horizontal: For such conditions as exposed lintels, sills, door and window heads, parapets, and reveals, maximum variation of the following from level:
    - a. 1/8 in (3 mm) in 10 ft (3 m).



- b. 1/4 in (6 mm) in 20 ft (6 m).
  - c. 1/2 in (12 mm) overall.
- B. Exposed Head Joints:
  - 1. Vertical Alignment: Maximum variation of the following from plumb:
    - a. 1/4 in (6 mm) in 10 ft (3 m).
    - b. 1/2 in (12 mm) from plumb top to bottom of wall.
  - 2. Thickness: Maximum variation from width indicated of plus or minus 1/8 in (3 mm); maximum variation from adjacent bed joint and head joint thicknesses 1/8 in (3 mm).
- C. Exposed Bed Joints: Maximum variation from width indicated of plus or minus 1/8 in (3 mm), with a maximum thickness limited to 1/2 in (12 mm); maximum variation from bed joint thickness of adjacent courses of 1/8 in (3 mm).
- D. Flush Alignment: Maximum variation of 1/16 in (1.5 mm) except due to warpage of masonry veneer units with tolerances specified for warpage of units.
- E. Stack Bond: For exposed head joints and bed joints, maximum variation from a straight line of 1/16 in (1.5 mm) from one masonry veneer unit to next.

### **3.13 FIELD QUALITY CONTROL**

- A. Manufacturer Field Service: Manufacturer qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Manufacturer Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Testing and Inspection of In-Progress Work: Owner may employ and pay a qualified independent testing agency to perform following testing of in-progress Work. Retesting of materials failing to meet specified requirements shall be at Contractor's expense.
  - 1. Testing: Testing agency will test and evaluate Work during construction.
  - 2. Mortar Tests: Verify mortar composition with specified requirements according to ASTM C 780, Annex A4.
  - 3. Inspections: Testing agency will visit project site periodically at random, but not less than once during each week of masonry veneer Work, to inspect progress and to ascertain if Work complies with Contract Documents. Allow inspectors access to scaffolding and Work areas, as needed to perform inspections. Inspections will include verification that:
    - a. Materials are properly stored.
    - b. Installation is within specified construction tolerances.
    - c. Proper mortar ingredients and mixing techniques are being used.

- d. Mortar time on board is within specified limits.
  - e. Bed and head joints are being properly made.
  - f. Masonry cavity is being kept clean.
  - g. Ties and anchorages are as specified.
  - h. Joints are being properly tooled.
  - i. Flashing assembly is being properly fabricated and installed.
  - j. Weeps and vents are being installed and are functional.
  - k. Masonry veneer expansion joints are being installed as indicated or as specified.
4. Evaluation of Quality Control Tests: Replace Work in areas where test results fail to comply with requirements indicated.

### **3.14 ADJUSTING**

- A. Repairs for Damage: Remove and replace masonry veneer units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units and install fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes, except weeps and vents, and completely fill with mortar. Point up all joints including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of sealants, where indicated.

### **3.15 CLEANING**

- A. In-Progress Cleaning: As soon as practical, clean masonry veneer as Work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.
- B. Protection: Prior to Final Cleaning, protect surrounding areas, landscaping, adjacent surfaces, and vehicles from contact with cleaning products.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry veneer as follows:
  1. Protect adjacent and nearby materials, especially windows and glass, to avoid damage.
  2. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  3. Test cleaning methods on mock-ups; leave one half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of permanent masonry veneer.
  4. Clean masonry veneer by means recommended by cleaning product manufacturer using masonry cleaner compound as recommended and approved by masonry veneer and mortar manufacturers.
  5. Avoid drifting of cleaning spray caused by wind.

### **3.16 MASONRY VENEER FINISH SCHEDULE**

- A. Face Brick Masonry Unit - Basis of Design: MVXX

1. Manufacturer:
2. Product Series:
3. Color Name and Number:
4. Face Style:
5. Color Selection:
6. Size (Actual Dimensions)
  - a. Unit Designation: Standard.
  - b. Width: 3-1/2 in 3-5/8 in (89 mm to 92 mm).
  - c. Height: 2-1/4 in (56 mm).
  - d. Length: 7-5/8 in (190 mm).
  - e. Vertical Coursing: 3 within 8 in (200 mm).
7. Bond Pattern:

B. Calcium Silicate Masonry Unit - Basis of Design: MVXX

1. Manufacturer:
2. Product Series:
3. Color Name and Number:
4. Face Style:
5. Color Selection:

**END OF SECTION**

## SECTION 05 52 14 - ORNAMENTAL AND MISCELLANEOUS METALS

### 1.0 GENERAL

#### 1.1 DESCRIPTION

- 1.1.1 Furnish materials, labor, tools, equipment, services, operations and incidentals necessary to complete all miscellaneous and ornamental exterior sitework metal work indicated on the drawings and specified, including all supplementary parts, anchors, sockets, inserts, bolts, hardware or other accessories required to complete and install each item and provide a functional system in accordance with OSHA and ADA regulations. Appropriate structural calculations for metallic railings, stairs, guardrails shall be provided to show conformance with design requirements of applicable codes. Live loads, dead loads, and impact loads shall be considered. Calculations should also include sizing of anchor bolts, welds, etc.
- 1.1.2 Work under this section includes all exterior sitework related ornamental and miscellaneous metals that are not part of the structural steel or parts that are specifically included in other sections. Where such items are included and specified in other sections in the specifications, but by trade agreements and jurisdictions the work must be executed under this section, it shall be the responsibility of the Contractor to coordinate the furnishing and installing of such items. Architectural and items inside proposed buildings are not included in this specification.
- 1.1.3 Many items indicated on the drawings are described and detailed to the extent that it is not necessary to list them in the specifications. The fact that the items are not included or listed in this section does not relieve the Contractor of the responsibility of furnishing and installing these items.

### 2.0 SHOP DRAWINGS AND SUBMITTALS

- 2.1 Submit shop drawings for each fabricated metal item specified herein or indicated on the drawings. Show pertinent details of construction and connection to other work; list all materials, gauges, thicknesses, finishes, colors, fasteners, anchors, and other similar items that completely describe how the items are fabricated and installed. Contractor shall verify dimensions in the field to insure fit. Shop drawings shall be submitted for approval prior to fabricating items.
- 2.2 Cut sheets and specifications on manufactured items shall be submitted for approval prior to ordering items. Submittal shall include complete description of each item, listing all materials, finishes, thicknesses, gauges, anchoring, method of connection to adjoining work and other similar data that completely describe each item and how the item is to be installed.
- 2.3 The contractor shall furnish samples of manufactured items and custom fabricated items for review and approval.

### 3.0 FIELD MEASUREMENTS

Contractor shall accurately field measure all job conditions and indicate these conditions and dimensions on all shop and installation drawings.

## PART 2 - PRODUCTS

### 1. MATERIALS

- A. Steel, not otherwise specified: Standard Specifications for Structural Steel for bridges and buildings, serial designation A7, of ASTM, as amended to date.

- B. Cast Iron: Soft, tough, gray iron, ASTM A-48-48.
- C. Aluminum bars, rods, extrusions, pipe and tube: ASTM B221, alloy 6063.
- D. Galvanized steel pipe: Federal Specification WW-P-406, type 2, zinc coated.
- E. Steel sheets and strips: Federal Specification QQ-S-636.
- F. Stainless Steel: Type 304, 18-8 composition, finishes as indicated on each item.
- G. Steel Tubing: Mechanical welded, bright finish steel tube.
- H. Paint Primer: Pittsburg Speedhide Inhibitive Red Primer.
- I. Grout: Por-Rok Cement, as manufactured by Hallemite Lehn & Fink Industries, Products Division of Sterling Drug, Inc.
- J. Black Pipe: Extra strong, conforming to ASTM Specification A53, Grade B.

## 2. ITEMS

- A. Pipe handrails and railings shall be fabricated of 1 1/2" OD extra strong black pipe. All joints shall be welded solid, welds ground smooth. Railing shall be inserted into steel plate/pipe handrail anchors, or bolt down anchor plates, as indicated on the drawings.
- B. Steel Ladders (General): 24" wide, length indicated on the drawings or as required to span job conditions, fabricated of low carbon steel with 3" x \_" square steel tubing rails, 3/4" diameter rungs spaced 12" o.c. Extend rungs through rails, and weld. Provide anchors at top, bottom and 4'-0" o.c. between design to hold ladder 8" clear of face of wall.
- C. Ships ladder shall be fabricated of 10" x 15.3 channel stringers, 8" galvanized welded treads with checkered plate nosing, 1-1/2" diameter pipe rail and mounting brackets. Treads shall be welded to stringers continuous along the entire joint, on both sides. Provide shoe brackets secured to concrete floor and wall and welded to stringers. Pipe rail shall be welded to stringer.
- D. Hangers, where necessary or required, shall be 1/2" threaded rods, secured to 1/2" wedge rod anchor set in concrete and 1 - 1/2" x 3" Unistrut Rack Mounting Channel. Provide a minimum of two hangers per installation.
- E. Provide miscellaneous steel angles that are not part of the structural steel.
- F. Furnish and install miscellaneous steel members for bracing of hollow metal door frames, changes in ceiling heights and other similar conditions.

Material shall be steel angles, channels, plates, brackets, and similar types of items welded to form structural frame or support as indicated on the drawings or as required by job conditions. Secure miscellaneous items to structural system. Hollow metal door frames located in steel stud partitions shall have steel channel or steel angle extensions or bracing from the frame to the structural system above.

- G. Furnish and install all miscellaneous steel angle sections indicated on the drawings, or as required by job conditions, for lintels carrying masonry over openings and miscellaneous bracing, clip angles and like items.
- H. Furnish and install all miscellaneous steel angles, channels, brackets, fasteners, etc.,

required to support wall-mounted equipment, ceiling-mounted equipment, floor-mounted equipment and other similar related items of equipment as indicated on the drawings. Items shall be welded construction, secured to building to support items indicated.

- I. Furnish and install other miscellaneous structural shapes where indicated on drawings or required but not specified.

### PART 3 - EXECUTION

#### 1. WORKMANSHIP

- A. Perform workmanship to highest standards for trade involved; carefully assemble work true to lines, planes, and design.
- B. Use templates and patterns for proper fitting of hardware and other accessories.
- C. Perform welding continuous along entire line of contact, except where tack welding is permitted. Where exposed, grind welds smooth in conformance with American Welding Society Code for Welding in Building Construction, latest edition. Where specified, welds are to be filled and sanded before painting.
- D. Perform bolting, where indicated or permitted with proper size of bolts. Draw nuts tight and upset threads except where tack welding is permitted. All bolts, nuts, washers, etc., exposed to the elements shall be cadmium plated or non-rusting type.
- E. Insofar as possible, fit and shop assemble work ready for erection. Execute work in strict accordance with drawings, details and approved shop drawings. Shop and/or field weld connections except where nature of material or item specifically calls for other means of fastening. Such fasteners shall in all cases be countersunk and finished flush with exposed surfaces.
- F. All items constructed of ferrous metals shall be either shop primed or field primed with specified paint. Items shop primed shall be touched up in field after installation. Where components are assembled to conceal part of the metal, the concealed metal shall be primed and painted prior to fabrication. Final finish of the metal shall be as noted on the drawings or specifications. Paint color shall be selected by the Owner.

#### 2. INTEGRATION WITH THE WORK

Provide all items to appropriate trade when such items are to be built into masonry, concrete, tile, etc., prior to time required by that trade. Measure all construction prior to fabrication of metal items to assure perfect fit.

END OF SECTION

**SECTION 05 5000**  
**METAL FABRICATIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Metal fabrications and supplementary items necessary for installation.

**1.2 DEFINITIONS**

- A. Unprotected Areas: Exterior areas directly that are exposed to the elements such as rain, snow, or ice.
- B. Protected Areas: Interior and exterior areas that are not directly exposed to the elements such as rain, snow, or ice.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Manufacturer/fabricator's technical literature for each product and system indicated.
  - 1. Include manufacturer/fabricator's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Welding Certifications: Certificates for welding procedures and personnel.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- D. Manufacturer/Fabricator's Project Acceptance Document: Certification that products are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- E. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- C. Welding Qualifications: Qualify procedures and personnel according to following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel".

## **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.7 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate installation of anchorages for metal fabrications. 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.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.



## **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer/fabricator. Provide secondary materials only as recommended by manufacturer/fabricator of primary materials.

## **2.3 FERROUS METAL MATERIALS**

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, blemishes, or other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.
- B. Steel:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  - 2. Steel Tubing: ASTM A 500, cold-formed steel tubing.
  - 3. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless another weight is indicated or required by structural loads.
  - 4. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
  - 5. Finish:
    - a. Unprotected Areas: Galvanized metal.
    - b. Protected Areas: Uncoated ferrous metal.

## **2.4 NON-FERROUS METAL MATERIALS**

- A. Aluminum Plate and Sheet: ASTM B 209/B 209M, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221/B 221M, Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

## **2.5 FASTENERS**

- A. Fastener Type and Material: Select fasteners for type, grade, and class required to produce connections suitable for anchoring fabrications to other types of construction indicated.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307/F 568M, Grade A/ ASTM F 568M, Property Class 4.6; with hex nuts, ASTM A 563/A 563M; and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593/F 738M; with hex nuts, ASTM F 594/F 836M; and, where indicated, flat washers; and as follows:
  - 1. Protected Areas:
    - a. Alloy Group 1 (A1) for Type 304.
  - 2. Unprotected Areas:

- a. Alloy Group 1 (A1) for Type 304.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563/ A 563M; and, where indicated, flat washers. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Plain Washers: Round carbon steel, ASME B18.22.1/ASME B18.22M.
- F. Lock Washers: Helical, spring type carbon steel, ASME B18.21.1/ASME B18.21.2M.
- G. Eyebolts: ASTM A 489.
- H. Machine Screws: ASME B18.6.3/B18.6.7M.
- I. Lag Screws: ASME B18.2.1/B18.2.3.8M.
- J. Wood Screws: ASME B18.6.1, flat head, carbon steel.

## **2.6 ANCHORS**

- A. General: Provide anchors capable of sustaining, without failure, a load equal to 6 times load imposed when installed in unit masonry and 4 times load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- B. Cast-in-Place Anchors in Concrete: Bolts, washers, and shims as needed, either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel; hot-dip galvanized according to ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Protected Areas:
    - a. Steel: Carbon steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
    - b. Stainless Steel: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593/F 738M; with hex nuts, ASTM F 594/F 836M; and, where indicated, flat washers; Alloy Group 1 (A1) for Type 304.
    - c. Locations: Where specified or where indicated on drawings.
  - 2. Unprotected Areas: Stainless steel bolts, ASTM F 593/F 738M, and nuts, ASTM F 594/F 836M; and as follows:
    - a. Alloy Group 1 (A1) for Type 304.
  - 3. Post-Tensioned Concrete Locations: Anchors shall not exceed 1 in (25 mm) embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.

## **2.7 MANUFACTURED PRODUCTS**

- A. Anti-Slip Coating:

1. Description: Proprietary material and application process that forms permanent, uniform, slip resistant surface texture on metals.
2. Color: As selected from manufacturer/fabricators standard colors available.
3. Static Coefficient of Friction Characteristics: Not less than 0.6 according to ASTM D 2047.
4. Manufacturer/Fabricators:
  - a. IKG Industries, Division of Harsco Corporation.
  - b. SlipNOT Metal Safety Flooring, W. S. Molnar Company.

## **2.8 PAINT MATERIALS**

- A. Paint for Steel Fabrications: As specified in Division 09 Section "Painting".
- B. Galvanizing Repair Paint for Steel Fabrications in Unprotected Areas: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

## **2.9 ACCESSORY ITEMS**

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28 day compressive strength of 3000 psi (210.92 k/cm), unless otherwise indicated.
- C. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer/fabricator.

## **2.10 FABRICATION, GENERAL**

- A. Fabrication Quality Standard for Fixed Ladders: In addition to standards listed elsewhere, comply with following, unless otherwise specified in this Section:
  1. Standard Ladders: ANSI A14.3.
  2. Elevator Pit Ladders: ASME A17.1.
- B. General: Fabricate metal fabrications, including clips, brackets, and other components necessary to support and anchor fabrications to supporting structure, and to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.
  1. Join components by welding unless otherwise indicated.
- C. Shop Assembly: Assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces.
- D. Fabrication Requirements:
  1. Shear and punch metals cleanly and accurately. Remove burrs and ease exposed edges to a radius of approximately 1/32 in (0.8 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

2. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
3. Form work true to line and level with accurate angles and surfaces and straight sharp edges.
4. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
5. Unprotected Areas:
  - a. Allow for thermal movement resulting from 120 deg F (49 deg C) change (range) in ambient and 180 deg F (82 deg C) surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - b. Fabricate hot-dip galvanized fabrications so that field assembly will be by bolted connections and not welding.
  - c. Fabricate joints exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

E. Assembly Requirements:

1. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
3. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/4 in by 1-1/4 in (6 mm by 31 mm), with a minimum 6 in (150 mm) embedment and 2 in (50 mm) hook, not less than 8 in (200 mm) from ends and corners of units and 24 in (600 mm) on center, unless otherwise indicated.
4. Complete fabrication prior to shop painting or hot-dip galvanizing.

F. Shop-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. Weld corners and seams continuously to develop full strength of member to comply with following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

## 2.11 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4 in (19 mm) bolts, spaced not more than 6 in (150 mm) from ends and 24 in (600 mm) on center, unless otherwise indicated.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.

## **2.12 MISCELLANEOUS FRAMING AND SUPPORTS**

- A. General: Provide steel framing and supports that are not a part of structural framework as necessary to complete the Work.
- B. Fabricate units from structural-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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
  - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 in (32 mm) wide by 1/4 in (6 mm) thick by 8 in (200 mm) long at 24 in (600 mm) on center, unless otherwise indicated.

## **2.13 MISCELLANEOUS STEEL TRIM**

- A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 in (150 mm) from each end, 6 in (150 mm) from corners, and 24 in (600 mm) on center, unless otherwise indicated.

## **2.14 FINISHES, GENERAL**

- A. Finish Quality Standard: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Finish metal fabrications after assembly.
  - 2. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

## **2.15 STEEL FINISHES**

- A. Unprotected Areas:
  - 1. Galvanized Finish: Hot-dip galvanize according to following. For surfaces to be painted, do not quench or apply post galvanizing treatments that might interfere with paint adhesion. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
    - a. Steel and Iron Products: ASTM A 123.
    - b. Steel and Iron Hardware: ASTM A 153.
  - 2. Cleaning: After galvanizing, thoroughly clean surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- B. Protected Areas:
  - 1. Shop Priming: Comply with Division 09 Section "Painting" and as follows:

- a. Preparation of Uncoated Surfaces: Prepare uncoated surfaces to comply with requirements of coating product to be used, but not less than minimum requirements of SSPC-SP 6/NACE No. 3 surface preparation specifications and environmental exposure conditions of installed fabrications.
  - b. Application: SSPC-PA 1; apply shop primer to uncoated surfaces. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- C. Field-Applied Coatings: As specified in Division 09 Section "Painting". Paint all steel fabrications unless noted otherwise.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive metal fabrications and associated Work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer/fabricator's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer/fabricator's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF METAL FABRICATIONS**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. 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 fabrications. Set accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Connections at Unprotected Areas: 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 units that have been coated or finished after fabrication and are intended for bolted or screwed field connections or other means without further cutting or fitting.

- D. Field Welding: Weld connections continuously to develop full strength of member to comply with 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 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.
- E. Corrosion Protection: Coat concealed aluminum surfaces that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with heavy coat of bituminous paint.

### **3.5 INSTALLATION OF MISCELLANEOUS ITEMS**

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturer/fabricators' written instructions and requirements indicated on Shop Drawings.
- B. Stair Nosings at Cast-in-Place Concrete Stairs: Install with anchorage system to comply with manufacturer/fabricator's written instructions. Center nosings on tread widths to within 3 in (75 mm) of ends. Align nosings flush with riser faces and level with tread surfaces.

### **3.6 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.7 ADJUSTING AND CLEANING**

- A. Touch-Up Painting: 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. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces at Unprotected Areas: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

**END OF SECTION**

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

**05 5000 - 10**

**METAL FABRICATIONS**



## SECTION 06 1053

### MISCELLANEOUS ROUGH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Miscellaneous rough carpentry and supplementary items necessary for installation.
  - 1. Section also includes composite plastic lumber materials.

##### 1.2 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 in nominal (38 mm actual) or greater, but less than 5 in nominal (114 mm actual) in least dimension.
- B. Lumber Grading Agencies:
  - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
  - 2. NHLA: National Hardwood Lumber Association.
  - 3. NLGA: National Lumber Grades Authority.
  - 4. SPIB: The Southern Pine Inspection Bureau.
  - 5. WCLIB: West Coast Lumber Inspection Bureau.
  - 6. WWPAA: Western Wood Products Association.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 2. Preservative-Treated Wood: 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, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
  - 3. Fire-Retardant-Treated Wood: 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, both before and after exposure to elevated temperatures when tested according to ASTM D 5664.
  - 4. Waterborne-Treated Wood: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
  - 5. Warranties: Include copies from chemical treatment manufacturers for each type of treatment.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Building Code Evaluation Reports: Published reports from model code organization, acceptable to authorities having jurisdiction, that following evidences compliance with building code in effect for the Project.
  - 1. Preservative-treated wood.
  - 2. Fire-retardant-treated wood.
- B. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

#### **1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Stack lumber flat with spacers between each bundle. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

#### **1.7 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

#### **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.

- B. Miscellaneous Rough Carpentry within Roofing System Assemblies: Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing system assembly and flashings shall be fabricated and installed to withstand specified uplift pressures and thermally induced movement without contributing to failure of roofing system or flashings.
- C. Surface Burning Characteristics for Fire-Retardant-Treated Wood: Products and construction identical to assemblies tested for fire resistance according to ASTM E 84/NFPA 255/UL 723 and included under Category BPVV published in Underwriters Laboratories, Inc. (UL) "Fire Resistance Directory"; or listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Flame Spread: Class A - no greater than 25.
  - 2. Smoke Developed: No greater than 450.

## 2.3 WOOD PRODUCTS

- A. Dimension Lumber:
  - 1. Material Quality Standards: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with applicable rules of any rules-writing agency certified by ALSC Board of Review. Provide lumber graded by an agency certified by ALSC Board of Review to inspect and grade lumber under rules indicated.
  - 2. Grade: Provide No. 2 grade, of any of following species:
    - a. Hem-fir (north); NLGA.
    - b. Hem-fir; WCLIB, or WWPA.
    - c. Mixed southern pine; SPIB.
    - d. Spruce-pine-fir; NLGA.
    - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
    - f. Douglas fir-larch; WCLIB or WWPA.
    - g. Douglas fir-larch (north); NLGA.
    - h. Douglas fir-south; WWPA.
    - i. Northern species; NLGA.
    - j. Eastern softwoods; NeLMA.
    - k. Western woods; WCLIB or WWPA.
  - 3. Grade Marking: Factory mark each piece of lumber with grade stamp of grading agency.
  - 4. Sizes: 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 lumber.
  - 5. Finish: Provide dressed lumber, sanded four sides, unless otherwise indicated.
  - 6. Maximum Moisture Content:
    - a. Provide kiln-dry lumber with 19 percent maximum moisture content at time of dressing for 2 in nominal (38 mm actual) thickness or less, for concealed conditions.
    - b. Provide kiln-dry lumber with 15 percent maximum moisture content at time of dressing for 2 in nominal (38 mm actual) thickness or less, for exposed conditions.
- B. Plywood:
  - 1. Material Quality Standard: DOC PS 1, Exposure 1.
  - 2. Grades: Furnish the grades below according to installation location:

- a. A-C; when exposed at occupied interior locations.
  - b. B-C; when exposed at mechanical and electrical equipment rooms.
3. Grade Marking: Factory mark each piece of plywood with grade stamp of grading agency.
  4. Thickness: Not less than 1/2 in (12 mm), unless indicated otherwise.

## **2.4 TREATED WOOD PRODUCTS**

### **A. Preservative-Treated Wood:**

1. Product Quality Standard: AWWA, Use Category UC4a, for species, product, preservative, and end use. Use preservative treatment that does not promote corrosion of metal fasteners.
2. Description: Wood products impregnated with chemicals by pressure process acceptable to authorities having jurisdiction, according to the following:
  - a. Listed in Section 4 of AWWA U1.
  - b. Containing no arsenic or chromium.
3. Field Preservative-Treatment for Cut Surfaces: Apply one of the following depending upon conditions listed below, in accordance with AWWA M4:
  - a. Continuously Protected from Liquid Water: Inorganic boron.
  - b. Not Continuously Protected from Liquid Water: Copper naphthenate.

### **B. Fire-Retardant-Treated Wood:**

1. Product Quality Standards: Provide materials that comply with performance requirements in AWWA C20 (lumber) and AWWA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction. Use fire-retardant treatment that does not promote corrosion of metal fasteners.
  - a. Concealed Wood Blocking: Chemical formulations for fire retardant treatment to contain a compatible, non-bleed, light fast, colored dye to identify and indicate treatment.
2. Description: Wood products impregnated with chemicals by pressure process, or other means acceptable to authorities having jurisdiction, having following characteristics:
  - a. Fire-retardant-treated materials shall comply with performance requirements specified above after being subjected to accelerated weathering according to ASTM D 2898.
  - b. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
  - c. Use Interior Type A High Temperature (HT), unless otherwise indicated.

### **C. Moisture Content: Kiln-dry wood after treatment to following maximum moisture content:**

1. 19 percent for lumber.
2. 15 percent for plywood.

- D. Quality Marking: Identify with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

## **2.5 FASTENERS**

- A. Fastener Types and Materials: Select fasteners for type, grade, and class required. Unless otherwise indicated, furnish Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 / F 1941M, Class Fe/Zn 5, within roofing system assemblies.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: ICC-ES NER-272.
- D. Powder-Actuated Fasteners: ANSI A10.3; low velocity, powder-actuated fasteners; drive pins and washers fabricated from corrosion-resistant materials; powder loads suitable for application indicated; and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
- E. Wood Screws: ASME B18.6.1, flat head, carbon steel.
- F. Screws for Fastening to Metal Framing: As specified in the following locations.
  - 1. Division 05 Section "Cold-Formed Steel Framing".
  - 2. Division 09 Section "Gypsum Board Assemblies".
- G. Lag Bolts: ASME B18.2.1/ASME B18.2.3.8M.
- H. Bolts: Steel bolts complying with ASTM A 307, Grade A / ASTM F 568M, Property Class 4.6; with ASTM A 563 / ASTM A 563M hex nuts and, where indicated, flat washers.

## **2.6 ANCHORS**

- A. Anchors: Capable of sustaining, without failure, a load equal to 6 times load imposed when installed in unit masonry and 4 times load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- B. Cast-in-Place Anchors in Concrete: Bolts, washers, and shims as needed, either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 / A 47M malleable iron or ASTM A 27 / A 27M cast steel; hot-dip galvanized according to ASTM F 2329.
- C. Post-Installed Anchors:
  - 1. Generic Type: Torque-controlled expansion anchors.
  - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 / F 1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 3. Material for Exterior Locations and where Stainless Steel is indicated: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products, fabrications, and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
- C. General Requirements:
  - 1. Securely attach Work to substrate according to authorities having jurisdiction.
  - 2. Select fasteners of appropriate size, type, and length that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Predrill members when necessary to avoid splitting wood while installing fasteners. Do not countersink nail heads, unless otherwise indicated. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
  - 3. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber.
  - 4. Do not use material with the following conditions:
    - a. Material that is warped or does not comply with requirements for untreated material.
    - b. Materials with defects that interfere with function of member.
    - c. Pieces which are too small to use with minimum number of joints or optimum joint arrangement.
  - 5. Set carpentry to required levels and lines, with members plumb, true to line, and level. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
  - 6. Apply field preservative-treatment to cut surfaces of preservative-treated wood.
  - 7. Where preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Schedule of Applications:
  - 1. Preservative-Treated Wood: Use preservative-treated wood for the following applications.

- a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing systems.
  - b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
2. Fire-Retardant-Treated Wood: Use fire-retardant-treated wood for the following applications:
    - a. Concealed wood blocking within interior partitions.
    - b. Exposed plywood backing panels supporting equipment at interior locations.
  3. Untreated Wood: Not allowed.

### **3.3 WOOD BLOCKING AND NAILER INSTALLATION**

- A. Install where indicated and where required for attaching other work. Coordinate locations with other work involved.
- B. Securely attach items to substrates to support applied loading.

### **3.4 PLYWOOD INSTALLATION**

- A. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- B. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

### **3.5 PROTECTION**

- A. General: Protect untreated wood, and wood that has been treated with chemicals that can leach, from deterioration due to weather.

**END OF SECTION**

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

**MISCELLANEOUSE ROUGH CARPENTRY**

**06 1053 - 8**



## SECTION 06 1643

### EXTERIOR GYPSUM SHEATHING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Exterior gypsum sheathing products and supplementary items necessary for installation.
- B. Related Section:
  - 1. Refer to Division 7 section for applicable Air and Water Barrier system and related requirements. Ensure compatibility of joint treatment components with Air and Water Barrier system.

##### 1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms not defined in this Section or in other referenced quality standards.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- E. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

## **1.5 QUALITY ASSURANCE**

### **A. Installer Qualifications:**

1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.

## **1.6 PRE-INSTALLATION CONFERENCE**

### **A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.**

#### **1. Participants:**

- a. Architect.
- b. Contractor, including superintendent.
- c. Installer, including project manager and supervisor.
- d. If requested, Manufacturer's qualified technical representative.
- e. Installers of other construction interfaced with Work.

#### **2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:**

- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
- b. Review Contract Document requirements.
- c. Review approved submittals.
- d. Review inspection and testing requirements.
- e. Review environmental conditions and procedures for coping with unfavorable conditions.
- f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.

#### **3. Record discussions, including decisions and agreements, and prepare report.**

## **1.7 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.**

## **1.8 PROJECT CONDITIONS**

- ### **A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.**
- ### **B. Exposure Limitation: Exterior gypsum sheathing shall not be exposed to weather for more than 180 days.**

## **1.9 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
  - 1. Ensure compatibility of joint treatment components with Air and Water Barrier systems incorporated into project.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  - 1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor defects for a period of 5 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Exterior Gypsum Sheathing Boards:
  - 1. Generic Type: Glass-mat faced exterior gypsum sheathing board.
  - 2. Material Quality Standard: ASTM C 1177 / C 1177M, Type X.
  - 3. Description: Paperless, treated, water resistant, noncombustible, gypsum core with inorganic glass mat partially or completely embedded on both faces; acrylic coated on one face; 5/8 in (15 mm) thick. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
  - 4. Manufacturers and Products:
    - a. CertainTeed Corporation; GlasRoc Sheathing, Type X.
    - b. Georgia-Pacific Gypsum LLC; DensGlass Gold Fireguard Type X Sheathing.
    - c. National Gypsum Company; Gold Bond Brand eXP Fire-Shield Extended Exposure Sheathing.

- d. United States Gypsum Company (USG); Securock Firecode Type X Glass-Mat Sheathing.

C. Vertical Cover Boards (Back of Parapet):

1. Generic Type: Glass-mat faced exterior gypsum sheathing board specifically manufactured for use beneath roofing systems.
2. Material Quality Standard: ASTM C 1177 / C 1177M, Type X.
3. Description: Non-combustible moisture-resistant gypsum core with glass-mat facings and a non-asphaltic coating on one face; 5/8 in (15 mm) thick. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
4. Manufacturers and Products:
  - a. Georgia-Pacific Gypsum LLC; DensDeck Prime.
  - b. USG; SECUROCK Gypsum-Fiber Roof Board.

D. Horizontal Roof Cover Boards: As specified in Division 07 Section for roofing membrane.

E. Screw Fasteners:

1. Material Quality Standards:
  - a. Metal Framing Members less than 0.030 in (0.75 mm) Thick: ASTM C 1002, Type S.
  - b. Metal Framing Members from 0.033 in to 0.112 in (0.79 mm to 2.9 mm) Thick: ASTM C 954, Type S-12.
2. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, steel screws with Phillips-head recess of size, holding power, and other properties recommended by manufacturer; minimum 1 in (25 mm) long; with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
3. Limitation: Nails and staples are not permitted.

F. Joint Treatment Materials:

1. General: Joint treatment materials shall be acceptable to board manufacturer and air and water barrier system manufacturer for use in sealing joints, and with a history of successful in-service use
2. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers in sealing joints in glass-mat gypsum sheathing.
3. Air Barrier Membrane Mastic:
  - a. Description: Single component, liquid-applied, non-asphaltic, vapor permeable rubberized (elastomeric) membrane which cures to a seamless monolithic rubber-like membrane to resist air leakage.
  - b. Water Vapor Permeance: 25 perms per ASTM E 96, Procedure B.
  - c. Basis of Design: Confirm compatibility of Air and Water Barrier system.
    - 1) Henry Company; Air-Bloc 31 Liquid Emulsion Vapor Permeable Air Barrier Membrane.
    - 2) Dupont; Tyvek Fluid Applied Flashing and Joint Compound.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standard: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. GA-253.
  - 2. ASTM C 1280.
  - 3. Respective manufacturer's written installation instructions.
  - 4. Accepted submittals.
  - 5. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION**

- A. Installation of Exterior Gypsum Sheathing Boards[ and Back of Parapet Boards].
  - 1. Install boards with coated face out, with panel lengths oriented vertically or horizontally as recommended by manufacturer, with vertical edges centered over flanges of studs, with edges and ends fitted tightly together.
  - 2. Do not install imperfect, damaged, wet, or damp boards.
  - 3. Cut boards at penetrations, edges, and other obstructions of the Work; fit tightly against abutting construction, except provide maximum 3/8 in (10 mm) setback where boards abuts structural elements or materials that may retain moisture.
  - 4. Coordinate installation of boards with flashing and joint treatment so materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
  - 5. Install screws at perimeter and within field to each stud approximately 8 in (200 mm) on centers; set back minimum 3/8 in (10 mm) from edges and ends; apply so screw heads bear tightly against board face but do not cut into facing.
  - 6. Do not bridge building expansion joints with boards; cut and space edges to match spacing of structural support elements.
- B. Joint Treatment Installation at Exterior Gypsum Sheathing Boards[ and Back of Parapet Boards]:

1. Coordinate installation with applicable Air and Water Barrier system to ensure compatibility of joint treatment.
2. Apply glass-fiber mesh tape to joints between boards.
3. Trowel apply air barrier membrane mastic over the top of glass-fiber mesh tape and at penetrations, openings, and edges where boards terminate at walls, floors, columns, or other structural elements.

### **3.5 FIELD QUALITY CONTROL**

- A. **Manufacturer's Field Service:** Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  1. **Manufacturer's Technical Representative Qualifications:** Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.6 PROTECTION**

- A. **Procedures:** Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions. Remove and replace products that are exposed to weather for more than number of days allowed by manufacturer.

**END OF SECTION**

## SECTION 06 4023

### INTERIOR ARCHITECTURAL WOODWORK

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Shop-finished interior architectural woodwork and supplementary items necessary for installation.
- B. Simulated Stone Countertops: Refer to Division 12 Section "Simulated Stone Countertops" for solid surfacing, quartz agglomerate, or cultured marble countertops incorporated into work specified in this Section. Simulated stone trim is specified in this Section.

##### 1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- B. Stair Work and Rails: Rough carriages for stairs are a part of interior architectural woodwork. Platform framing, headers, partition framing, and other rough framing associated with stairwork are specified in Division 06 Section "Miscellaneous Rough Carpentry".
- C. Exposed Surfaces, Semi-Exposed Surfaces, Concealed Surfaces, Types of Cabinet Construction, and other related terms are defined in referenced quality standards.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 2. Wood Veneered Items: Include finishing materials and processes.
  - 3. Fire Retardant Treated Wood: Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.

4. Wood Paneling with Transparent Finish: For paneling noted or schedule to be blueprint matched work, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples for Initial Selection: For each type of product for which a color has not yet been specified, provide manufacturer's color charts consisting of units or sections of units showing the full range of colors available.
- D. Samples for Verification:
1. Items with Transparent Finish:
    - a. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm) or 5 in (125 mm) wide by 24 in (600 mm) long, for each species and cut, finished on 1 side and 1 edge.
    - b. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
    - c. Veneer-faced panel products with or for transparent finish, 8 in by 10 in (200 mm by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
  2. Items with Opaque Finish:
    - a. Lumber and panel products with shop-applied opaque finish, 50 sq. in. (300 sq. cm) for lumber and 8 in by 10 in (200 mm by 250 mm) for panels, for each finish system and color, with 1/2 of exposed surface finished.
  3. Items with Plastic Laminate Finish:
    - a. Plastic laminates, 8 in by 10 in (200 mm by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
  4. Simulated Stone Trim: 6 in (150 mm) long.
  5. Cabinets:
    - a. Corner Piece: Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 in (450 mm) high by 18 in (450 mm) wide by 6 in (150 mm) deep.
    - b. Cabinet Hardware and Accessories: Exposed cabinet hardware and accessories, one unit for each type and finish.
    - c. Countertops: Section of countertop showing top, front edge, and backsplash construction.
  6. Standing and Running Trim: Corner piece showing miter joints.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.



1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- B. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  3. Certification: Certified participant in AWI's Quality Certification Program or licensee of WI's Certified Compliance Program.
- C. Source Limitations for Wood Veneered Items: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork.
- D. Quality Standard: Unless otherwise indicated, comply with "Architectural Woodwork Standards" for standards and for grades of interior architectural woodwork indicated for construction, finish, installation and other requirements:
1. Provide manufacturer certification indicating that woodwork complies with requirements of referenced quality standards.
  2. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
  3. Provide WI-certified compliance labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
  4. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.
- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated or required, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- F. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.

4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

G. Mock-ups, Cabinets:

1. One full-size sample of finished base cabinet unit complete with hardware, doors, and drawers, but exclusive of countertop.
2. One full-size sample of finished wall-mounted cabinet unit complete with hardware, doors, and adjustable shelves.
3. Accepted sample units will be used as a standard for judging the completed work. Unless otherwise directed, accepted sample units may be incorporated in work. If not incorporated in work, retain accepted sample units at Project site until completion of work and remove sample units from premises when directed by Architect.

## 1.5 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:
  - a. Architect.
  - b. Contractor, including superintendent.
  - c. Installer, including project manager and supervisor.
  - d. If requested, Manufacturer's qualified technical representative.
  - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
  - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate Shop Drawings and fabrication with hardware requirements.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Provide materials that comply with requirements of "Architectural Woodwork Standards" quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

### **2.3 MATERIALS**

- A. Wood Species and Cut for Transparent Finish:
  - 1. Selections: As scheduled or as indicated in Design Selections.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood unless indicated otherwise.
- C. Fire Retardant Wood Products for Paneling:
  - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
  - 2. Particleboard: ANSI A208.1, Industrial Grade M-2, 43 pcf (689 kgm3) Density.
  - 3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

- D. Wood Products for Cabinets:
1. Hardboard for Vertical Dividers Only: AHA A135.4, tempered, smooth two sides, 1/4 in (6 mm) minimum thickness unless indicated otherwise.
  2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
  3. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
  4. Softwood Plywood: DOC PS 1.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Fire-Rated Laminates: Where indicated or scheduled; NEMA LD 3, grades as follows:
    - a. Vertical Surfaces: General Purpose Type 604 (VGF), 0.032 in (0.79 mm) thick.
    - b. Horizontal Surfaces: General Purpose Type 605 (HGF) 0.048 in (1.2 mm) thick.
  2. Manufacturers:
    - a. Formica Corporation.
    - b. International Paper.
    - c. Lamin-Art, Inc.
    - d. Nevamar Company, LLC; Decorative Products Div.
    - e. Pioneer Plastics Corp.
    - f. Westinghouse Electric Corp.; Specialty Products Div.
    - g. Wilsonart International; Div. of Premark International, Inc.
  3. Colors, Patterns, and Finishes:
    - a. Selections: As scheduled or as indicated in Design Selections.
- F. Chemical-Resistant, High-Pressure Decorative Laminate: NEMA LD 3, Grade HGP, and as follows:
1. Laminate has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.9.5:
    - a. Nitric Acid (30 Percent): Moderate effect.
    - b. Sulfuric Acid (77 Percent): Moderate effect.
    - c. Hydrochloric Acid (37 Percent): Moderate effect.
    - d. Phosphoric Acid (75 Percent): No effect.
    - e. Acetic Acid (98 Percent): No effect.
    - f. Formaldehyde: No effect.
    - g. Ethyl Acetate: No effect.
    - h. Ethyl Ether: No effect.
    - i. Phenol (85 Percent): Moderate effect.
    - j. Benzene: No effect.
    - k. Xylene: No effect.
    - l. Butyl Alcohol: No effect.
    - m. Furfural: No effect.
    - n. Methyl Ethyl Ketone: No effect.
    - o. Sodium Hydroxide (25 Percent): No effect.
    - p. Sodium Sulfide (15 Percent): No effect.
    - q. Ammonium Hydroxide (28 Percent): No effect.

- r. Zinc Chloride: No effect.
  - s. Gentian Violet: No effect.
  - t. Methyl Red: No effect.
- 2. Manufacturers and Products:
    - a. Formica Corporation; Lab Grade 840 Black.
    - b. Panolam Industries International Incorporated; Pionite Chemguard.
    - c. Wilsonart International, Div. of Premark International, Inc.; Chemsurf.
  - 3. Colors, Patterns, and Finishes:
    - a. Selections: As scheduled or as indicated in Design Selections.
- G. PVC Laminate: Fire-retardant acrylic/PVC sheet covered in a decorative rigid PVC veneer, 0.040 in (1 mm) thick.
- 1. Manufacturer and Product: Spectrim; Ven4ma.
  - 2. Colors, Patterns, and Finishes:
    - a. Selections: As scheduled or as indicated in Design Selections.
- H. Simulated Stone Trim:
- 1. Solid Surface Material: Homogeneous solid pieces of filled plastic resin complying with ANSI SS1.
    - a. Manufacturers:
      - 1) Avonite Surfaces.
      - 2) E. I. du Pont de Nemours and Company.
      - 3) Formica Corporation.
      - 4) LG Chemical, Ltd.
      - 5) Meganite Inc.
      - 6) Samsung Chemical USA, Inc.
      - 7) Swan Corporation (The).
      - 8) Transolid, Inc.
      - 9) Wilsonart International.
  - 2. Quartz Agglomerate: Solid pieces consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
    - a. Manufacturers:
      - 1) Cambria.
      - 2) Cosentino USA.
      - 3) E. I. du Pont de Nemours and Company.
      - 4) LG Chemical, Ltd.
      - 5) Meganite Inc.
      - 6) Samsung Chemical USA, Inc.
      - 7) Technistone USA, Inc.
      - 8) Transolid, Inc.

3. Colors, Patterns, and Finishes:
  - a. Selections: As scheduled or as indicated in Design Selections.

## **2.4 FIRE-RETARDANT-TREATED MATERIALS**

- A. General: Where fire-retardant-treated materials are indicated or required, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
  1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or 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 UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment types:
  1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
  2. Interior Type A: Low-hygroscopic formulation.
  3. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
  4. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles 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 25 or less per ASTM E 84.
- D. Fire-Retardant Fiberboard: 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 per ASTM E 84.

## **2.5 CABINET HARDWARE AND ACCESSORIES**

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Hinges: Provide number of hinges recommended by hinge manufacturer for size and weight of door.
- C. Butt Hinges: 2-3/4 in (69 mm), 5-knuckle steel hinges made from 0.095 in (2.4 mm) thick metal, and as follows:

1. Semi-concealed Hinges for Flush Doors: BHMA A156.9, B01361.
  2. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- D. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602,
1. Product Standard: Grass, "Tiomos 120 Series", 120 degree swing, self-closing from 10 deg.
- E. Back-Mounted Pulls: BHMA A156.9, B02011.
- F. Wire Pulls: Back mounted, solid metal, 4 in (100 mm) long, 5/16 in (8 mm) in diameter.
1. Product Standard: EPCO-MC-402-4, 4 in (100 mm) center to center of screws, 1-5/16 in (34 mm) projection, 5/16 in (8 mm) diameter. Stainless steel.
- G. Catches: Magnetic catches, BHMA A156.9, B03141.
- H. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- I. Shelf Rests: BHMA A156.9, B04013; metal.
1. Product Standard: K & V No. 345, nickel plated.
- J. Drawer Slides: BHMA A156.9, B05091.
1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
  2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 in (150 mm) high and 24 in (600 mm) wide.
    - a. Product Standard for 24 in (600 mm) Wide and Less: Full extension; Accuride "7434".
    - b. Product Standard for Wider than 24 in (600 mm): Full extension; Accuride "7432".
  3. File Drawer Slides: Grade 1HD-200; for drawers more than 6 in (150 mm) high or 24 in (600 mm) wide.
    - a. Product Standard for 42 in (1050 mm) Wide and Less: Full extension with 1 in (25 mm) over travel; Accuride "3640".
  4. Pencil Drawer Slides: Grade 1; for drawers not more than 3 in (75 mm) high and 24 in (600 mm) wide.
    - a. Product Standard for 16 in (400 mm) Wide and Less: Low profile, 75 lb (34 kg) load rating (at 2/3 travel), full extension; Accuride "2632".
    - b. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.
    - c. Product Standard for Slides Only, 16 in (400 mm) Wide and Less: Adjustable height, 75 lb (34 kg) load rating; Accuride "2109".
    - d. Product Standard for Slides and Tray: Fixed tilt, adjustable height; Accuride "Cbergo-Tray 200".

- e. Product Standard for Slides, Tray and Accessories: Adjustable tilt, adjustable height, cable management, palm rest, and mouse pad; Accuride "Cbergo-Tray 300".
- 5. Trash Bin Slides: Grade 1HD-200; for trash bins not more than 20 in (500 mm) high and 16 in (400 mm) wide.
- K. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
- L. Door Locks: BHMA A156.11, E07121.
  - 1. Product Standard: K & V No. 984, nickel plated.
- M. Drawer Locks: BHMA A156.11, E07041.
  - 1. Product Standard: K & V No. 986, nickel plated.
- N. Sliding Door Locks:
  - 1. Product Standard: K & V No. 984, nickel plated.
- O. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Size: 1-1/4 in (32-mm) or 2 in (50 mm) OD as indicated.
  - 2. Color: Brown or black as indicated.
  - 3. Product Standards: Doug Mockett & Company, Inc "OG or SG Series" or Hafele 429.93.
- P. Concealed Pocket Door Slides (Vertical Swing/Slide/Retract):
  - 1. Description: Side mounted flipper door slide assembly suitable for recessed full overlay door, 42 in (1050 mm) high and less, 30 lb (14 kg) load rating, into concealed pocket within cabinet, painted steel slides with all steel ball bearings.
  - 2. Product Standard: Accuride – "1321".
- Q. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Stainless Steel: BHMA 630, unless otherwise indicated.
- R. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
  - 1. Table Legs:
    - a. Product Standard: Richelieu; Round Table Legs, Product UC250175, 28 in (711.2 mm) long by 2-1/2 in (62 mm) diameter steel table leg with satin chrome finish.
- S. Tackable Wall Surface: Refer to Division 09 Section "Fabric Wrapped Panels".

## 2.6 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 nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives:
  - 1. General: As recommended by woodwork fabricator to suit application.
  - 2. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) unless indicated otherwise:
    - a. Wood Glues: 30 g/L.
    - b. Contact Adhesive: 250 g/L.
  - 3. Adhesive for Bonding Plastic Laminate Faces and Edges: PVA as recommended by woodwork fabricator to suit application.
- D. Hanging Clips: Provide manufacturer's standard nonferrous-metal or hot-dip galvanized zee hanging clips.

## **2.7 FABRICATION, GENERAL**

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium Grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fire Retardant Treated Wood: Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 in (19 mm) Thick or Less: 1/16 in (1.5 mm).
  - 2. Edges of Rails and Similar Members More Than 3/4 in (19 mm) Thick: 1/8 in (3 mm).
- E. Complete fabrication, including assembly, finishing, 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.
  - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, 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. Countertops: Seal edges of openings in countertops.
- G. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual". For glass in wood frames, secure glass with removable stops.

## **2.8 PLASTIC-LAMINATE CABINETS**

- A. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay unless indicated otherwise.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
1. Horizontal Surfaces Other Than Tops: Grade HGP, .038 in (1 mm) thick.
  2. Postformed Surfaces: Grade HGP, .038 in (1 mm) thick.
  3. Doors and Vertical Surfaces: Grade VGS, .028 in (0.7 mm) thick.
  4. Edges: PVC Edge Banding, 0.12 in (3 mm) thick, matching laminate in color, pattern, and finish.
  5. Edges: Grade HGS, .048 in (1.2 mm) thick.
- D. Semi-exposed Surfaces: Provide surface materials indicated below:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade CLS, .020 in (0.5 mm) thick.
  2. Edges: PVC Edge Banding, .038 in (1 mm) thick, matching laminate in color, pattern, and finish.
  3. Drawer Sides, Backs and Sub-Fronts: 1/2 in (12 mm) minimum thickness, as indicated.
    - a. Solid-hardwood lumber.
  4. Drawer Bottoms: 1/4 in (6 mm) minimum thickness, as indicated.
    - a. Hardwood plywood with veneer core.
    - b. High pressure decorative laminate with veneer core plywood.
  5. Drawer Box Construction: One of the following:
    - a. Glued multiple dovetail.
    - b. Glued French dovetail.
    - c. Glued and doweled.

- 6. Interior Drawer Box Finish, as indicated:
  - a. Clear catalyzed polyurethane.
  - b. High-pressure decorative laminate, Grade CLS, .020 in (0.5 mm) thick.
  
- E. Body Members (Ends, Divisions, Bottoms and Sub-Tops): Medium-density fiberboard, 3/4 in (19 mm) minimum thickness.
- F. Face Frames, Rails, Kicks and Bases: Solid-hardwood lumber or hardwood plywood, 3/4 in (19 mm) thick minimum thickness.
- G. Face Frames and Rails: Solid-hardwood lumber or hardwood plywood, 3/4 in (19 mm) thick minimum thickness.
- H. Kicks and Bases: Solid-hardwood lumber, 1 1/2 (38 mm) thick minimum thickness.
- I. Shelves: Hardwood plywood with veneer core with the following thickness:
  - 1. For Spans Up To 32 in (800 mm): 3/4 in (19 mm).
  - 2. For Spans Up To 42 in (1050 mm): 1 in (25 mm).
- J. Drawer Fronts: Medium density fiberboard, 3/4 in (19 mm) thick minimum thickness.
- K. Doors:
  - 1. Hinged Flush Type: Medium density fiberboard with minimum thickness of 3/4 in (19 mm).
    - a. Maximum cabinet door size: 24 in (600 mm) width and 84 in (2100 mm) height.
    - b. Maximum cabinet door size: 20 in (500 mm) width and 84 in (2100 mm) height.
    - c. For Doors Larger than Sizes Above: 1-3/8 in (35 mm) or 1-3/4 in (45 mm) doors; refer to Division 08 Section "Flush Wood Doors".
    - d. If hinge screws enter only edge of door, provide 3/4 in (19 mm) lumber edges glued to core prior to laminating.
  - 2. Sliding Flush Type: As required by referenced quality standard for grade specified.
  - 3. Stile and Rail Type: As required by referenced quality standard for grade specified.
- L. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL, .020 in (0.5 mm) thick.
- M. Concealed Edges of Base Cabinet Panels: Including but not limited to floors, vertical edges, splashes and countertops; Clear Catalyzed Polyurethane.

## **2.9 PLASTIC-LAMINATE COUNTERTOPS**

- A. Grade: Premium.
- B. High-Pressure Decorative Laminate Grade:

1. High-Pressure Decorative Laminate Grade for Flat Countertops: Grade HGS, .048 in (1.2 mm) thick.
  2. High-Pressure Decorative Laminate Grade for Post-formed Countertops: Grade HGP, .038 in (1.0 mm) thick.
- C. Grain Direction for Wood Grain Laminates: Parallel to cabinet fronts.
- D. Edge Treatment: PVC edge banding, 0.12 in (3 mm) thick, matching laminate in color, pattern, and finish, as indicated.
- E. Core Material for Countertops: Medium-density fiberboard made with exterior glue, 3/4 in (19 mm) thick minimum thickness.
- F. Core Material for Side and Back Splashes: Medium-density fiberboard made with exterior glue, 1/2 in (13 mm) thick minimum thickness.
- G. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, .020 in (0.5 mm) thick, on underside of countertop substrate.
- H. Concealed Backs and Edges at Side and Back Splashes: High-pressure decorative laminate, Grade BKL, .020 in (0.5 mm) thick.

## **2.10 SOLID SURFACING COUNTERTOPS**

- A. Refer to Division 12 Section "Simulated Stone Countertops".

## **2.11 QUARTZ AGGLOMERATE COUNTERTOPS**

- A. Refer to Division 12 Section "Simulated Stone Countertops".

## **2.12 CLOSET AND UTILITY SHELVING**

- A. Grade: Custom.
- B. Shelf Material: 3/4 in (19 mm) solid lumber or veneer-faced panel product with solid-lumber edge.
- C. Cleats: 3/4 in (19 mm) solid lumber.

## **2.13 SHOP FINISHING**

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to Division 09 Painting Sections for material and application requirements.

- D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
  - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate.
- E. Finish:
  - 1. Selections: As scheduled or as indicated in Design Selections.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive interior architectural woodwork and associated work to which interior architectural woodwork will be applied for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Quality standards. (The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.)
  - 2. Respective manufacturer/fabricator's written installation instructions.
  - 3. Accepted submittals.
  - 4. Contract Documents.

#### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

#### **3.4 INSTALLATION**

- A. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication, to extent that it was not completed in the shop.
- B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 in per 96 in (3 mm per 2400 mm).
- C. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Cabinets, General: Install without distortion so doors and drawers fit openings properly 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.
  - 1. Install cabinets with no more than 1/8 in per 96 in (3 mm per 2400 mm) sag, bow, or other variation from a straight line.
- F. Base and Wall Cabinets: Set base cabinets straight, level, and plumb. Adjust subtops within 1/16 in (1.5 mm) of a single plane. Fasten base cabinets to partition framing, or reinforcements in partitions with fasteners spaced 24 in (600 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
  - 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 in (600 mm) on center. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
  - 2. Wall Cabinets: Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 in (400 mm) on center with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish or toggle bolts through metal backing or metal framing behind wall finish.
- G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Where possible make field jointing 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.
  - 2. Plastic Laminate Countertops: Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 in (150 mm) of front and back edges and at intervals not exceeding 24 in (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
  - 3. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
  - 4. Simulated Stone Countertops: Refer to Division 12 Section "Simulated Stone Countertops".
  - 5. Install countertops with no more than 1/8 in per 96 in (3 mm per 2400 mm) sag, bow, or other variation from a straight line.

6. Secure backsplashes to tops with concealed metal brackets at 16 in (400 mm) on center and to walls with adhesive.
  7. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants".
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

### **3.5 ADJUSTING AND CLEANING**

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

**END OF SECTION**

**18-01.01 WPMHC Expansion  
Childers Architect  
2019-12-06**

**INTERIOR ARCHITECTURAL  
WOODWORK**

**06 4023 - 18**



**SECTION 06 6400**

**PLASTIC (FRP) PANELING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.
- B. Related Sections:
  - 1. Division 10 Section "Wall and Corner Guards" for adhesive-applied impact-resistant wall protection systems labeled as Plastic Wall Protection.

**1.2 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Samples for Initial Selection: For plastic paneling and trim accessories.
- D. Samples for Verification: For plastic paneling and trim accessories, in manufacturer's standard sizes.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

**1.4 QUALITY ASSURANCE**

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
  - 3. Testing Agency: Acceptable to authorities having jurisdiction.

**1.5 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

- B. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## **1.6 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PLASTIC SHEET PANELING**

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.

- 1. Manufacturers:

- a. Crane Composites (Kemlite)
- b. Marlite.
- c. Nudo Products, Inc.

- 2. Nominal Thickness: Not less than 0.09 in (2.3 mm).

- 3. Surface Finish: Molded pebble texture.

- 4. Color: As scheduled or as indicated in Design Selections.

### **2.4 ACCESSORIES**

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

- 1. Color: Match panels.

- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

- D. Adhesive: As recommended by plastic paneling manufacturer.

1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 Section "Joint Sealants."
1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. At existing partitions-to-remain:
1. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
  2. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 in (300 mm) wide.
1. Mark plumb lines on substrate at trim accessory locations for accurate installation.

2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

### **3.4 INSTALLATION**

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

### **3.5 FINISH SCHEDULE**

- A. Color: As selected by Architect from manufacturer's full range.

**END OF SECTION**

## THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Thermal insulation products and systems and supplementary items necessary for installation.

#### 1.2 DEFINITIONS

- A. Mineral Fiber: Insulation composed principally of fibers manufactured from rock, slag or glass, with or without binders.
- B. Mineral Wool: A synthetic vitreous fiber insulation made by melting predominantly igneous rock, and or furnace slag, and other inorganic material, and then physically forming the melt into fibers

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects
- B. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.

#### 1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect 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 plastic insulating materials to Project site before installation time.
  3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **1.7 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

- B. General: Provide insulating materials that comply with requirements and referenced standards in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. Plenum Rating: Provide glass mineral fiber (fiberglass) insulation to be installed within ceiling plenums rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or by comparable tests from another standard acceptable to authorities having jurisdiction.
  - 1. Erosion Test Results: No visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500 fpm (13 m/s) air velocity.
  - 2. Mold Growth and Humidity Test Results: No evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.
- B. Fire-Test-Response Characteristics:
  - 1. Fire Resistance Ratings: Materials and construction identical to assemblies tested for fire resistance according to ASTM E 119/NFPA 251/UL 263 and included under Categories listed below that are published in Underwriters Laboratories, Inc. (UL) "Fire Resistance Directory"; or listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Polystyrene Insulation: Category CCVW.
    - b. Mineral Fiber Insulation: Category BZJZ
  - 2. Surface Burning Characteristics: Materials and construction identical to assemblies tested for fire resistance according to ASTM E 84/NFPA 255/UL 723 by an independent testing and inspecting agency acceptable to authorities having jurisdiction listed below. Identify products with appropriate markings of applicable testing agency.
  - 3. Fire Rated Assembly Design: Selected from Product Category BXUV published in UL's "Fire Resistance Directory", or design of other testing agency acceptable to authorities having jurisdiction.
  - 4. Combustion Characteristics: Materials and construction identical to assemblies tested for fire resistance according to ASTM E 136 by an independent testing and inspecting agency acceptable to authorities having jurisdiction

### **2.4 GLASS MINERAL FIBER (FIBERGLASS) BATT INSULATION**

- A. Unfaced Insulation:
  - 1. Description: ASTM C 665, Type I, ASTM C553, Type II. Unfaced blankets produced by bonding inorganic glass mineral fibers with a thermosetting binder; free of formaldehyde.
  - 2. Manufacturers and Products:
    - a. CertainTeed Corporation; CertaPro Sustainable Insulation.
    - b. Johns Manville; Unfaced Batts for Metal Framing.
    - c. Knauf Insulation; EcoBatt with ECOSE Technology.
    - d. Owens-Corning; EcoTouch Thermal Batts for Metal Frame Construction.

3. Surface Burning Characteristics per ASTM E 84:
  - a. Flame spread: 25 or less.
  - b. Smoke developed: 50 or less.
4. Thickness: Full depth of metal stud cavity.

## **2.5 GLASS MINERAL FIBER (FIBERGLASS) SEMI-RIGID INSULATION**

- A. Description: ASTM C 612, Type IA or Types IA and IB. Unfaced, semi-rigid boards produced by bonding inorganic glass mineral fibers with a thermosetting binder.
- B. Manufacturers and Products:
  1. CertainTeed Corporation; CB-300.
  2. Johns Manville; Insul-SHIELD 300.
  3. Knauf Insulation; Insulation Board with Ecosse Technology; 3.00 PCF.
  4. Owens-Corning; 703.
- C. deg F (29.8 K x m/W at 24 deg C).
- D. Surface-Burning Characteristics per ASTM E 84:
  1. Flame spread: 25 or less.
  2. Smoke developed:
    - a. Exposed-to-View or Concealed Spaces other than Return Air Plenums: 450 or less.
    - b. Return Air Plenums: 50 or less.
- E. Thickness: As indicated but not less than 2 in (50 mm).
- F. Other-than-Cavity Wall Locations:
  1. Unfaced: ASTM C 612, Types IA and IB. Unfaced rock mineral wool board insulation.
    - a. Location: Typical unless noted to be foil-faced.
  2. Foil-Faced: ASTM C 612, Types IA and IB. Rock mineral wool board insulation faced with foil-scrim-kraft vapor-retarder membrane.
    - a. Location: Where indicated on drawings for non-fire-rated perimeter conditions and/or for spandrel insulation.
  3. Density: Nominal density of 4 lb/cu. ft. (64 kg/cu. m), thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
  4. Surface Burning Characteristics per ASTM E 84:
    - a. Flame spread: 25 or less.
    - b. Smoke developed: 50 or less.
  5. Thickness: As indicated on drawings but not less than required for an R-value of 19.
  6. Fiber Color: Regular color, unless otherwise indicated.
  7. Manufacturers:



- a. Rock Wool Manufacturing Company.
- b. Roxul, Inc.
- c. Themafiber, Inc.

**2.6 EXTRUDED POLYSTYRENE RIGID INSULATION**

- A. Description: Unfaced, rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process, and with other requirements indicated in this Article.
  - 1. Surface Burning Characteristics per ASTM E 84:
    - a. Flame Spread: 25 or less.
    - b. Smoke Developed: 450 or less.
  - 2. Adhesive for Bonding Insulation: Product compatible with insulation being bonded and with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation or substrates.
- B. Cavity Wall Locations:
  - 1. Product Quality Standard: ASTM C 578, Type IV, 25 psi minimum compressive strength.
  - 2. Size: 2 in (50 mm) thick by 16 in (400 mm) high by 96 in (2400 mm) long, square edges.
  - 3. R-Value: 10
  - 4. U-Value: 0.1
  - 5. Manufacturers and Products:
    - a. Dow Chemical Company; Styrofoam CavityMate Plus
    - b. Owens Corning; FOAMULAR CW25
    - c. Pactiv Building Products Division; GreenGuard Type IV 25.
- C. Other-than-Cavity Wall Locations:
  - 1. Product Quality Standard: ASTM C 578 of following type and minimum compressive strength for the following locations:
    - a. Slabs-on-Grade: Type VI, 40 psi (276 kPa).
    - b. Backfilled Walls: Type IV, 25 psi (173 kPa).
  - 2. Manufacturers and Products:
    - a. Type IV:
      - 1) DiversiFoam Products; CertiFoam 25.
      - 2) Dow Chemical Company; STYROFOAM Square Edge.
      - 3) Owens Corning; FOAMULAR 250.
      - 4) Pactiv Building Products Division; GreenGuard Type IV 25.
    - b. Type VI:
      - 1) DiversiFoam Products; CertiFoam 40.
      - 2) Dow Chemical Company; STYROFOAM Roofmate or Highload 40.
      - 3) Owens Corning; FOAMULAR 400 or 404.
  - 3. Thickness: As indicated but not less than 2 in (50 mm).

## 2.7 POLYISOCYANURATE RIGID INSULATION

- A. Refer to Division 07 roofing section(s) for polyisocyanurate rigid insulation used as roofing insulation.

## 2.8 SPRAYED FOAM INSULATING GAP FILLER

- A. As specified in Division 07 Section "Joint Sealants".

## 2.9 SPRAY-APPLIED THERMAL INSULATION

- A. Spray-Applied Thermal Insulation:
  - 1. Description: Glass mineral fiber insulation spray applied for thermal or acoustic applications.
    - a. Thermal Resistance: ASTM C 518; R-Factor = 4 per 1 in (25 mm).
    - b. Noise Reduction Coefficient: ISO 354; NRC 0.75 at 1 in (25 mm), 0.95 at 2 in (50 mm)
  - 2. Surface Burning Characteristics:
    - a. Flame spread: Class A; 25 or less.
    - b. Smoke developed:
      - 1) Exposed-to-View or Concealed Spaces other than Return Air Plenums: 450 or less.
      - 2) Return Air Plenums: 50 or less.
  - 3. Thickness: As indicated on drawings but not less than required for an R-value of 19.
  - 4. Density: As required for application.
  - 5. Manufacturer and Product: Monoglass Incorporated; Monoglass Spray-On Insulation, white color.
- B. Spray-Applied Protective Coating: Manufacturers' standard protective coating for sealing a tamped insulation surface.
  - 1. Locations: Installations exposed to view in finished construction and for installations in crawl spaces; and not indicated to have a vapor retarder.
  - 2. Manufacturer and Product: Monoglass Incorporated; Insulseal, medium coating; color to be selected.

## 2.10 POLYETHYLENE VAPOR-RETARDER MEMBRANE

- A. Description: Fire-retardant reinforced polyethylene vapor-retarder membrane comprised of two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either a non-woven grid of nylon cord or polyester scrim.
  - 1. Physical Properties:
    - a. Vapor Permeance: Maximum 0.13 perm (7.4 ng/Pa x s x sq. m); ASTM E 96/E 96M.

- B. Surface Burning Characteristics:
  - 1. Flame Spread: 25 or less.
  - 2. Smoke Developed: 450 or less.
  
- C. Manufacturers and Products:
  - 1. Raven Industries; Dura-Skrim 2FR.
  - 2. Reef Industries, Inc., Griffolyn Type T-55 FR.
  
- D. Accessories:
  - 1. Sealing Tape: Asphalt based tape with double-sided adhesive and release liner provided by vapor-retarder manufacturer.
    - a. Manufacturers and Products:
      - 1) Raven Industries; Butyl Seal Tape (TP2BR).
      - 2) Reef Industries, Inc., Griffolyn Division; Fab Tape.
  
  - 2. Seaming Tape: Pressure-sensitive tape for seaming and bonding joints and penetrations in vapor-retarder membrane provided by vapor-retarder manufacturer.
    - a. Manufacturers and Products:
      - 1) Raven Industries; Vapor Bond Tape (TVB4).
      - 2) Reef Industries, Inc., Griffolyn Division; Pressure Sensitive Tape.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to which thermal insulation will be applied for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
  
- B. General Requirements:
  - 1. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, or snow.

2. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
3. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
4. Apply a single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF INSULATION SYSTEMS**

- A. Unfaced Glass Mineral Fiber (Fiberglass) Semi-Rigid and Batt Insulation: Install insulation in cavities formed by framing members according to following:
  1. Use insulation widths and lengths that fill the cavities formed by framing members. Where more than one length is required to fill cavity, 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. Where partition will be covered by gypsum board on only one side, apply adhesive to backside of gypsum board that is installed and press insulation in place to form bond to prevent insulation from sagging within cavity.
- B. Mineral Wool Semi-Rigid Insulation: Install in cavities formed by framing members according to the following requirements:
  1. Cavity Wall Installations:
    - a. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
    - b. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  2. Glazed Aluminum Framing System (Curtainwall) Installations:
    - a. 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. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
    - b. Install insulation to fit snugly without bowing.
    - c. Install mullion covers, minimum 8 in (200 mm) width of insulation, centered over horizontal and vertical aluminum frames within spandrel area using the same impaling pins as used to attach the curtainwall insulation material. Secure covers with clinch shields over impaling pins.
- C. Sprayed Foam Insulating Gap Filler: As specified in Division 07 Section "Joint Sealants".

- D. Sprayed-Applied Thermal Insulation: Comply with manufacturer's written instructions for application procedures, and types of equipment used to mix, convey, and spray on insulation material.
1. Cover adjacent work subject to damage from fallout or overspray of insulation materials during application. Provide temporary enclosure as required to confine spraying operations and ensure adequate ambient conditions for temperature and ventilation.
  2. Coat substrates with adhesive before applying insulation material where recommended in writing by manufacturer for material and application indicated.
  3. Extend insulation material in full thickness over entire area of each substrate to be protected.
  4. Spray-apply insulation materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by manufacturer.
  5. Apply insulation material in thicknesses and densities not less than those required to achieve minimum R-value indicated.
  6. Maintain profile of substrates except fill voids between members, including voids formed by fluted decks above beams and similar voids.
  7. Cure sprayed insulation materials according to manufacturer's recommendations to prevent premature drying.
  8. Protective Coating: Board-tamp sprayed insulation and over-spray with protective coating at installations that will be exposed to view in finished construction and for installations in crawl spaces.
    - a. Vapor Retarder Coating: Where indicated to have a vapor retarder, install this in lieu of protective coating. Board-tamp sprayed insulation and over-spray with vapor retarder coating.

### **3.5 PROTECTION**

- A. Protection: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation

**END OF SECTION**

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

**THERMAL INSULATION**

**07 2100 - 10**

## SECTION 07 2400

### EIFS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required for this Section includes flexible thin coat (polymer-based; Class PB) exterior insulation and finish system (EIFS) and supplementary items necessary to complete their installation.

##### 1.2 DEFINITIONS

- A. EIFS: Exterior Insulation and Finish System
- B. Class PB EIFS: As defined by ASTM C 1397 is a "nonload bearing, exterior wall cladding system that consists of an insulation board attached either adhesively, mechanically, or both to the substrate; an integrally reinforced base coat; and a texture protective finish coat."

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Obtain Shop Drawings of adjacent materials and products which penetrate surfaces of EIFS (i.e., windows, doors, etc.). Coordinate EIFS work with shop drawings of penetrating items.
- C. Samples for Verification: 24 in (600 mm) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including a typical control joint filled with sealant of color selected.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
  - 1. Product Approvals: Submit Florida Product Approval or Product Control Notice of Acceptance (NOA) issued by Miami-Dade County Building Code Compliance Office (BCCO) or other product approval acceptable to authorities having jurisdiction for systems used at exterior of building.
- B. Qualification Data:

1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- C. Warranty: Sample of warranty.
1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include joint sealant manufacturer's written interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
- E. Research/Evaluation Reports: Evidence of EIFS compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Maintenance Kit: Furnish maintenance kit to Owner to include the following:
1. Printed Maintenance Instructions.
  2. Adhesive: One gallon
  3. Base Coat Material: 1 gallon (3.8 L)
  4. Finish Coat Material: 1 gallon (3.8 L) for each color installed, from same batch as installed.
  5. Reinforcing Mesh: 20 sf (1.8 sq m)
  6. Insulation Board: 20 sf (1.8 sq m)

### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Fire-Test-Response Characteristics: Provide EIFS assemblies and system components with fire-test-response characteristics as determined by testing identical assemblies and components per test method by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting agency.
- D. Preconstruction Laboratory Testing: The Owner will employ and pay a qualified independent testing laboratory to perform the preconstruction testing indicated.



1. Construct mock-up units of the EIFS wall system for testing at the laboratory's test facilities.
  2. Mock-ups shall be complete with all components, finishes, and details of construction identical with those proposed for use in the building.
  3. Do not take special precautions or use techniques that do not represent those to be used on the building.
  4. Mock-ups shall be of sufficient size and configuration to demonstrate adequately the system's performance capabilities. Submit drawings of proposed mock-up to Architect prior to testing.
  5. Personnel assembling mock-ups at the laboratory shall be the personnel, to the extent possible, which will perform this work at the project site.
  6. Include EIFS, windows, doors, window wall if applicable, sealant joints and other conditions where EIFS abuts dissimilar materials.
  7. Schedule testing with sufficient time for analysis of results and to prevent delay in the progress of the Work.
  8. Test the EIFS wall system for compliance with requirements specified for performance and test methods.
  9. Test Mock-Up to failure and perform a "failure analysis" and subsequent report. Report shall be transmitted to the Owner, Architect, Contractor and EIFS Contractor.
- E. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
  - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## **1.8 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
- B. Environmental Limitations: Do not deliver, store or install system when ambient outdoor air and substrate temperatures are below or falling below minimum temperature recommended by system manufacturer unless temporary protection and heat are provided to maintain ambient temperatures above manufacturers minimum.

## **1.9 COORDINATION**

- A. Coordinate installation of EIFS with related Work specified in other Sections to ensure that wall assemblies, including sheathing, flashing, trim, joint sealers, windows, and doors, are protected against damage from the effects of weather, age, corrosion, moisture, and other causes. Do not allow water to penetrate behind EIFS and flashings.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturers written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
  1. Coverage of warranty includes but is not limited to the following:
    - a. Material defects, including, but not limited to, peeling, cracking, delamination, flaking or similar failures.
    - b. Seepage and leakage of water or excessive moisture into the building or wall cavities through the System, EIFS to EIFS and EIFS to dissimilar sealant joints.
  2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion.

- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 3 years from date of Substantial Completion
- C. Repair and replace defective work under the terms of the warranty at no cost to the Owner.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
  - 1. Dryvit Systems, Inc.
  - 2. Omega Products International, Inc.
  - 3. Parex
  - 4. Senergy
  - 5. Sto Corp.
  - 6. TEIFS Wall Systems

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Provide systems that comply with the following performance requirements:
  - 1. Bond Integrity: Free from bond failure within EIFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
  - 2. Weathertightness: Resistant to water penetration from exterior into EIFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of system and assemblies behind it, including substrates, supporting wall construction, and interior finish.
- B. Physical Properties: Provide Class PB EIFS whose physical properties and structural performance comply with the following when tested per methods referenced:
  - 1. Abrasion Resistance: Sample consisting of 1 in (25 mm) thick EIFS mounted on 1/2 in (12 mm) thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to 528 quarts of sand when tested per ASTM D 968, Method A.

2. Accelerated Weathering Characteristics: Sample of size suitable for test equipment and consisting of 1 in (25 mm) thick EIFS mounted on 1/2 in (12 mm) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 2000 hours when viewed under five times magnification per either ASTM G 23, Method 1 or ASTM G 53.
3. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
4. Mildew Resistance: Sample consisting of finish coat applied to 2 in (50 mm) by 2 in (50 mm) clean glass substrate; cured for 28 days; and showing no growth when tested per ASTM D 3273.
5. Salt-Spray Resistance: Sample consisting of 1 in (25 mm) thick EIFS mounted on 1/2 in (12 mm) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 300 hours per ASTM B 117.
6. Tensile Adhesion: No failure in the adhesive, base coat, or finish coat. Minimum 5-psi tensile strength before and after freeze-thaw and accelerated weathering tests per EIMA 101.03.
7. Water Penetration: Sample consisting of 1 in (25 mm) thick EIFS mounted on 1/2 in (12 mm) thick gypsum board; cured for 28 days; and showing no water penetration into the plane of the base coat to expanded polystyrene board interface of the test specimen after 15 minutes at 6.24 lbf/sq. ft. of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.
8. Impact Resistance: Sample consisting of 1 in (25 mm) thick EIFS when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the following impact classification and range:
  - a. Standard Impact Resistance: 25-49 inch-lb.
  - b. Medium Impact Resistance: 50-89 inch-lb.
  - c. High Impact Resistance: 90-150 inch-lb.
9. Positive and Negative Wind-Load Performance: Sample assembly, 48 in (1200 mm) by 48 in (1200 mm) in size, consisting of studs, sheathing, and 1 in (25 mm) thick EIFS; and showing capability to withstand wind loads indicated when tested per ASTM E 330.

C. Water-/Weather-Resistive-Barrier Coating: With physical properties that comply with the following when tested on substrate per methods referenced:

1. Tensile Adhesion: No failure in bond when 5 samples of water-/weather-resistive coating are applied to substrate and tested at a minimum 15-psi flatwise tensile strength per ASTM C 297.
2. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
3. Water Penetration: 3 samples each sized not less than 4 ft (1.22 m) by 8 ft (2.4 m); consisting of coating applied to substrate including a minimum of 2 vertical joints and 1 horizontal joint within sheathing substrate, each joint not less than 0.125 in (3.11 mm) wide; and tested sequentially as follows:
  - a. Passing 10 cycles at 80 percent positive design load (design load is defined as ultimate load with a safety factor of 3.0 imposed) as the maximum test load when tested in accordance with ASTM E 1233, Procedure A.
  - b. No water penetration on the plane of the exterior-facing side of substrate after 75 minutes at 6.24 lbf/sq. ft. of air-pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per ASTM E 331.

4. Water Resistance: 3 samples, each sized not less than 4 in (100 mm) by 6 in (150 mm) and consisting of coating applied to substrate, showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
5. Water Vapor Transmission: Three samples prepared by applying the coating, at recommended thickness, to a nonadhesive surface and removing cured coating film. Average thickness is determined from material density, area, and weight and samples are tested per ASTM E 96 after conditioning at 75 plus or minus 5 deg F and 50 percent relative humidity for 40 hours before testing, with results meeting or exceeding grade requirements in Table 14-1-A of UBC Standard 14-1.

## 2.3 MATERIALS

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials
- B. Compatibility: Provide waterproof membrane, adhesive, board insulation, reinforcing meshes, base- and finish-coat materials, sealants, and accessories that are compatible with one another and approved for use by EIFS manufacturer for Project.
- C. Colors, Textures, and Patterns of Finish Coat: Comply with the following requirements:
  1. Selections: As scheduled or as indicated in Design Selections.
- D. Waterproof Membrane and Air Barrier: Provide EIFS manufacturer's highly flexible, fiber reinforced, 100% acrylic polymer based, Portland cement modified waterproof protective coating designed to provide a waterproof, air and weather protective barrier for gypsum sheathing and other approved substrates.
- E. Adhesive for Application of Insulation: EIFS manufacturer's standard factory-mixed formulation, compatible with substrate and designed for adhesive attachment of insulation to substrates of type indicated.
- F. Molded-Polystyrene Board Insulation: Rigid, cellular thermal insulation formed by expansion of polystyrene resin beads or granules in a closed mold. Comply with EIFS manufacturer's requirements, ASTM C 578 for Type I, and "EIMA Guideline Specification for Expanded Polystyrene (EPS) Insulation Board" for more stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:
  1. Before cutting and shipping, age insulation in block form by air drying for not less than six weeks or by another method approved by EIMA that produces equivalent results.
  2. Provide insulation in boards not more than 24 in (600 mm) by 48 in (1200 mm) and in thickness indicated but not more than 4 in (100 mm) or less than that allowed by ASTM C 1397.
  3. Flame-Spread and Smoke-Developed Indexes of 25 and 450 or less, respectively, per ASTM E 84.
- G. Reinforcing Mesh: Balanced, alkali-resistant, open-weave glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. per EIMA 105.01, complying with ASTM D 578 and the following requirements for minimum weight:
  1. Standard Reinforcing Mesh: Not less than 4.0 oz./sq. yd.
  2. Intermediate Reinforcing Mesh: Not less than 10 oz./sq. yd.
  3. High-Impact-Resistant Reinforcing Mesh: Not less than 15 oz./sq. yd.

4. Strip Reinforcing Mesh: Not less than 3.75 oz./sq. yd.
  5. Detail Reinforcing Mesh: Not less than 4 oz./sq. yd.
  6. Corner Reinforcing Mesh: Not less than 7.2 oz./sq. yd.
- H. Standard Base-Coat Materials: EIFS manufacturer's standard recommended factory-mixed or factory-blended formulation of portland cement, polymer admixture, and inert fillers
- I. Waterproof Base-Coat Materials: EIFS manufacturer's standard waterproof mixture of portland cement complying with ASTM C 150, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use indicated.
- J. Finish-Coat Materials: EIFS manufacturer's standard factory-mixed mildew resistant formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers
- K. Water: Potable.
- L. Flashing Transition Membrane: EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer. One of the following:
1. Flexible Membrane Flashing: Self-adhering, self-sealing rubberized asphalt and polyethylene film composite sheet or tape and primer.
  2. Fluid Applied Membrane Flashing: Flexible, water based polymer coating with embedded mesh reinforcement.
- M. Soffit Vent: Extruded aluminum soffit vent 2 in (50 mm) wide by continuous. Locate where indicated on drawings.

## **2.4 ELASTOMERIC SEALANTS**

- A. Elastomeric Sealant Products: Provide EIFS manufacturer's listed and recommended chemically curing, elastomeric sealant that is compatible with joint fillers, joint substrates, and other related materials, and complies with requirements for products and testing indicated in "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems, Class PB" and with requirements in Division 07 Section "Joint Sealants" for products corresponding to description indicated below:
1. Low-modulus silicone sealant.
- B. Sealant Color: As scheduled or as indicated in Design Selections.

## **2.5 MIXING**

- A. General: Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer/fabricator's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- C. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind EIFS and deterioration of substrates.
- D. Prepare and clean substrates to comply with EIFS manufacturer's written requirements to obtain optimum bond between substrate and waterproof membrane.
  - 1. Verify vertical and horizontal board joints in sheathing, exposed edges at terminations, and inside and outside corners have been treated with 2 in (50 mm) glass fiber mesh tape.
  - 2. Trowel waterproofing membrane over sheathing board joints, inside and outside corners, exposed edges such as returns at wall openings and allow to dry.
  - 3. Trowel apply waterproofing mixture over the entire wall surface to a uniform thickness of approximately 3/32 in (0.08 m) and allow to completely dry.
  - 4. Once waterproofing has completely dried apply flashing transition membrane at head, jamb and sill of all wall penetrations, top of parapet if applicable and changes in substrate.

### **3.4 INSTALLATION OF INSULATION**

- A. Comply with ASTM C 1397 and EIFS manufacturer's written instructions for installation of system as applicable to each type of substrate indicated.
- B. Treat exposed edges of insulation board at terminations and openings as follows:

1. Wrap edges after installing insulation board and before applying field-applied reinforcing mesh.
  2. Wrap mesh of width required to extend not less than 2-1/2 in (62 mm) onto substrate behind insulation board, cover insulation board edge, and extend not less than 2-1/2 in (62 mm) onto insulation board face.
  3. Wrap edges of insulation board, except those forming substrates of sealant joints, by encapsulating with base coat, reinforcing mesh, and finish coat.
  4. Wrap edges of insulation board forming substrates of sealant joints within system or between system and other work by encapsulating with base coat and reinforcing mesh.
- C. Apply adhesive to insulation in a manner that results in full adhesive coating to back surface of insulation once insulation is adhered to waterproof membrane on sheathing.
- D. Press and slide insulation board into place. Apply pressure over the entire surface of the insulation board to accomplish uniform contact, high initial grab, and an overall level surface.
- E. Allow adhered insulation to remain undisturbed for period recommended by EIFS manufacturer, but not less than 24 hours, before beginning rasping and sanding insulation, or applying base coat and reinforcing mesh.
- F. Apply insulation boards over dry substrates in courses with long edges oriented horizontally. Begin first course from a level base line and work upward.
- G. Stagger vertical joints in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than 12 in (300 mm) wide or 6 in (150 mm) high. Offset joints not less than 6 in (150 mm) from corners of window and door openings.
1. Offset joints of insulation not less than 6 in (150 mm) from horizontal and 4 in (100 mm) from vertical joints in sheathing.
  2. Offset joints of insulation not less than 4 in (100 mm) from aesthetic reveals.
  3. Interlock ends at internal and external corners.
- H. Abut boards tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between insulation boards. If gaps greater than 1/16 in (1.5 mm) occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
- I. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated. Install foam shapes attached to supporting substrate, where indicated.
- J. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 in (0.8 mm) from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 in (1.5 mm).
- K. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at features to less than 3/4 in (19 mm).
- L. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.



1. Interrupt insulation for expansion joints where indicated.
- M. Coordinate flashing installation with installation of insulation to produce a wall system that does not allow water to penetrate behind waterproof coating.

### **3.5 INSTALLATION OF FINISH SYSTEM**

- A. Apply base coat in two application's to exposed surfaces of insulation in minimum thickness recommended in writing by EIFS manufacturer, but not less than 1/16 in (1.5 mm) dry-coat total thickness.
- B. Embed reinforcing mesh of type and classification indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 in (62 mm) or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written requirements. Do not lap reinforcing mesh within 8 in (200 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.

1. Locations:

- a. Standard Reinforcing Mesh: Typical unless noted or scheduled for a higher mesh.
- b. Intermediate Reinforcing Mesh: Where indicated or required.
- c. High-Impact-Resistant Reinforcing Mesh: Areas and facades exposed to abnormal stress or deliberate impacts including the following.

- 1) Facades abutting grade or paved areas to 7 feet (2.1 m) above grade or to the first horizontal breakpoint above 7 feet (2.1 m).
- 2) Balconies and/or terraces, full height.
- 3) Freestanding columns, full height.

- C. Double-Layer Application: Where indicated, to obtain higher impact resistance apply second base coat and second layer of reinforcing mesh, in the same manner as first application. Do not apply until first base coat has cured.

- D. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending 4 in (100 mm) beyond perimeter. Apply additional 9 in (255 mm) by 12 in (300 mm) strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8 in (200 mm) wide strip reinforcing mesh at both inside and outside corners, unless base layer of mesh is lapped not less than 4 in (100 mm) on each side of corners.

1. At aesthetic reveals, apply strip reinforcing mesh not less than 8 in (200 mm) wide.
2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.
3. Shapes: Fully embed reinforcing mesh in base coat.

- E. Apply finish coat over dry base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

### **3.6 INSTALLATION OF JOINT SEALANTS**

- A. Prepare joints and apply sealants, of type and at locations indicated, to comply with applicable requirements in Division 07 Section "Joint Sealants" and in "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems, Class PB."

1. Clean surfaces to receive sealants to comply with indicated requirements and EIFS manufacturer's written instructions.
2. Apply primer recommended in writing by sealant manufacturer for surfaces to be sealed.
3. Install sealant backing to control depth and configuration of sealant joint and to prevent sealant from adhering to back of joint.
4. Apply masking tape to protect areas adjacent to sealant joints. Remove tape immediately after tooling joints, without disturbing joint seal.
5. Apply joint sealants after base coat has cured but before applying finish coat.

### **3.7 CLEANING AND PROTECTING**

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.
- B. Provide final protection and maintain conditions, in a manner acceptable to Installer and EIFS manufacturer that ensure system is without damage or deterioration at the time of Substantial Completion.

### **3.8 FINISH SCHEDULE**

- A. Color and Texture / Sealant Color: Match existing.

**END OF SECTION**

## SECTION 07 2500

### MECHANICALLY FASTENED AIR AND WATER BARRIERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Air and water barriers, vapor permeable, located within exterior wall assemblies; and supplementary items necessary for installation.
- B. Related Section:
  - 1. Refer to Division 6 Section "Exterior Gypsum Sheathing for sheathing joint treatment. Joint treatment components to be compatible with air and water barrier system.
  - 2. Division 07 Section "EIFS" for air and water barrier that is a part of the EIFS wall assembly. Products specified in this "Air and Water Barrier" Section are not intended to be used with the EIFS wall assembly.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
  - 2. Include data on air and water-vapor permanence based on testing according to referenced standards.
- B. Samples: Actual samples for each of following:
  - 1. Air and Water Barrier Membrane: Minimum 8-1/2 in (212 mm) by 11 in (275 mm).
  - 2. Accessory Materials: Sample of each item.
- C. Shop Drawings: Show locations and extent of air and water barrier assemblies and details of typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings, bridging details for gaps in construction, inside and outside corners, attaching materials covering air and water barrier to maintain air-tight condition, sealing miscellaneous penetrations including conduits, pipes, electric boxes and similar items.
  - 1. Include statement that materials are compatible with adjacent materials proposed for use.
- D. Shop Drawings of Mock-Up: Submit shop drawings of proposed mock-ups showing plans, elevations, large-scale details, and connections to the test apparatus.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
  - 1. Evaluation Reports: For air and water-resistive barrier and flexible flashing, from ICC-ES.

- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its products and systems are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- E. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
  - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Build integrated mockups of exterior wall assembly, incorporating backup wall construction, external cladding, glazed aluminum framing, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    - b. If indicated, coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
    - c. Include junction with roofing membrane, building corners and, foundations.
  - 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  - 3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  - 4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  - 5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.5 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  - 3. Record discussions, including decisions and agreements, and prepare report.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store weather barrier materials as recommended by weather barrier manufacturer.

## **1.7 PROJECT CONDITIONS**

- A. Ambient Conditions: Install air and water barrier within range of ambient and substrate temperatures and moisture conditions as recommended by manufacturer. Protect substrates from environmental conditions that affect performance. Do not apply to a damp or wet substrate or during high humidity conditions including snow, rain, fog, or mist.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Schedule installation of exterior cladding within six months of weather barrier assembly installation.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
1. DuPont Co.; Tyvek CommercialWrap.
  2. Fiberweb; Typar MetroWrap.
  3. VaproShield; WrapShield.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
1. Basis of Design: DuPont; Tyvek CommercialWrap and related assembly components.

### 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### 2.3 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous air and water barrier and as a liquid-water drainage plane flashed to discharge to the exterior. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2. Assembly shall perform as a drainage plane flashed to discharge condensation or water penetration to the exterior.
  3. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air and water seal materials at such locations, changes in substrate and perimeter conditions.
  4. Assembly shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
  5. Assembly shall not displace adjacent materials under full load.
  6. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.
- B. Connections to Adjacent Materials: Provide connections to prevent air leakage and water migration at the following locations:
1. Foundation and walls, including penetrations, ties and anchors
  2. Walls, windows, curtain walls, storefronts, louvers or doors.
  3. Different wall assemblies and fixed openings within those assemblies.
  4. Wall and roof connections.
  5. Floors over unconditioned space.
  6. Walls, floor and roof across construction, control and expansion joints.
  7. Walls, floors and roof to utility, pipe and duct penetrations.
  8. Seismic and expansion joints.
  9. Other leakage pathways in the building envelope.

## 2.4 AIR AND WATER BARRIERS

- A. Air and Water Barrier: Spun-bonded polyolefin, non-woven, non-perforated air and water barrier; UV stabilized; and acceptable to authorities having jurisdiction.
1. Basis of Design: DuPont; Tyvek CommercialWrap, and related assembly components.
  2. Physical and Performance Properties:
    - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
    - b. Vapor Permeance: 10 perms (580 ng/Pa x s x sq. m) minimum; **ASTM E 96/E 96M, Water Method.**

## 2.5 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.
- B. Barrier Seaming Tape: Pressure sensitive, adhesive coated tape for sheet to sheet lap joints; width as recommended by barrier manufacturer; temperature and ultraviolet light degradation resistant; provided by barrier manufacturer.
1. Manufacturers and Products:
    - a. DuPont Co.; Tyvek Tape.
    - b. Fiberweb; Typar Tape.
    - c. VaproShield; VaproTape.
- C. Fasteners for Steel and Wood Frame Construction: Provided by barrier manufacturer.

1. Screws: Corrosion resistant, self-tapping drill point screws, shank size and length as required to penetrate steel stud flange by not less than 3 exposed threads.
  2. Caps: High-density polyethylene; ultraviolet light degradation resistant; not less than 2 in (50 mm) diameter.
  3. Limitation: Staples are not permitted nor will be allowed.
  4. Basis of Design: DuPont; Tyvek Wrap Cap Screws, 1-5/8 in (40 mm) rust resistant screw with 2 in (50 mm) diameter plastic cap fasteners.
- D. Sheathing Joint Treatment: Refer to Division 6 Section "Exterior Gypsum Sheathing". All components to be compatible with air and water barrier system.
- E. Adhesives: Provide adhesive recommended by weather barrier manufacturer.
- F. Primers: Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.
- G. Barrier Flashing Tape: Barrier material laminated to adhesive coated rubberized asphalt or butyl for sheet to surrounding construction sealing; width as recommended by barrier manufacturer; provided by barrier manufacturer.
1. Manufacturers and Products:
    - a. DuPont Co.; FlexWrap and StraightFlash.
    - b. Fiberweb; Typar Flashing Flex and Typar Flashing Peel & Stick.
    - c. VaproShield; Vapro Flashing.
- H. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- I. Nails and Staples: Not allowed.
- J. One-Piece Electrical Box:
  1. Description: Rigid reinforced polyethylene electrical box designed to prevent leaks at air and water barrier, with fixed or adjustable flange to suit installation conditions, with clear hinged weatherproof in-use cover.
  2. Available Product: Arlington Industries, Inc.; In Box.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.
1. Verify sealants and joint treatments used in sheathing are compatible with membrane.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:



1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Exterior Gypsum Sheathing Substrates: Joints treated under Division 06 Section "Exterior Gypsum Sheathing."

### **3.4 AIR AND WATER BARRIER INSTALLATION**

- A. General: Install air and water barrier sheets and accessory materials according to air-barrier manufacturer's written instructions.
- B. One-Piece Electrical Box: Install in accordance with manufacturer's recommendations. Cover shall project from face of wall surface enough to allow hinged cover to fully open for access.
- C. Air and Water Barrier Installation: Install multiple sheets to form continuously sealed sheet air and water barrier over indicated substrates.
1. Layout and arrange seams and laps so that they will not occur over exterior gypsum sheathing joints or fasteners.
  2. Beginning at bottom of substrate wall, accurately align horizontally; pull taut to eliminate fishmouths, wrinkles, buckles, and kinks; install in shingled manner to shed water without interception by exposed edges.
  3. Weather Barrier Attachment:
    - a. Steel or Wood Frame Construction: Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 6 in by 18 in (150 mm) by (450 mm) vertically on center along stud line, and 16 in (400 mm) on center, maximum horizontally.
    - b. Cladding Anchors: Apply 4 in (100 mm) by 7 in (175 mm) flashing tape to weather barrier membrane prior to the installation of cladding anchors.
  4. Install overlapping upper sheet over underlying lower sheet lapping 12 in (300 mm) minimum at horizontal joints and ends; stagger end laps; lap 12 in (300 mm) minimum at inside and outside corners; lap flashing 6 in (150 mm) minimum. Seal sheet-to-sheet seams with barrier seaming tape.
  5. Form bellows at expansion or control joint locations to allow movement.
  6. Seal joints and penetrations caused by pipes, conduits, electrical boxes, and similar items penetrating barrier with barrier flashing tape.
  7. At doors, windows, and other wall openings, extend or fold barrier into head, jamb, and sill substrates and seal according to manufacturer's instructions. Ensure barrier at head condition is properly lapped to prevent water infiltration.
  8. Repair punctures, tears, voids, damage, and deficiently lapped seams with barrier flashing tape extending 6 in (150 mm) minimum beyond damaged areas in all directions.
  9. Flexible Flashing Installation: Apply flexible flashing where indicated to comply with manufacturer's written instructions.

- a. Prime substrates as recommended by flashing manufacturer.
- b. Lap seams and junctures with other materials.
- c. Lap flashing over water-resistive barrier at bottom and sides of openings.
- d. Lap water-resistive barrier over flashing at heads of openings.
- e. After flashing has been applied, roll surfaces to ensure that flashing is completely adhered to substrates.

### **3.5 FIELD QUALITY CONTROL**

- A. **Manufacturer's Field Service:** Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  1. **Manufacturer's Technical Representative Qualifications:** Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. **Testing Agency:** The Owner may employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.
- C. **Testing Agency:** Employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.
- D. **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. Continuous structural support of air-barrier system has been provided.
  3. Substrate surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  4. Site conditions for application temperature and dryness of substrates have been maintained.
  5. Maximum exposure time of materials to UV deterioration has not been exceeded.
  6. Surfaces have been primed.
  7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction.
  8. Compatible materials have been used.
  9. Transitions at changes in direction and structural support at gaps have been provided.
  10. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
  11. All penetrations have been sealed.
- E. **Tests:** As determined by Owner's testing agency from among the following tests:
  1. **Quantitative Air-Leakage Testing:** Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
  2. Refer to Division 01 Section "Field Test for Water Leakage".

- F. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Remove and replace deficient air-barrier components for retesting as specified above.
- G. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

### **3.6 CLEANING AND PROTECTION**

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 180 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to 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 by manufacturer of affected construction.

**END OF SECTION**



**SECTION 07 4114**  
**METAL ROOF PANELS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Metal roof panel assemblies and supplementary items necessary for installation.

**1.2 DEFINITIONS**

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system installed over a continuous solid support system.
  - 1. Factory- or Site-Formed and Fabricated Installation: Work under this Section may be either factory- or site-formed and fabricated provided that installed assembly can be verified that it meets the specified performance requirements.

**1.3 DELEGATED ENGINEERING REQUIREMENTS**

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.
- B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
- C. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- D. Coordination of Work:
  - 1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.

2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  1. Include Manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Include the following:
  1. Show fabrication and installation layouts of metal roof panels.
  2. Show details of edge conditions, side-seam and end-lap joints, panel profiles, corners, anchorages, trim, flashings, closures, terminations, eaves, ridges, valleys, rakes, crickets, and counterflashings.
  3. Show details for forming metal roof panel assembly, including seams and dimensions.
  4. Show details for securing metal roof panel assembly, including layout of fasteners, cleats, clips, and other attachments.
  5. Show details of termination points and assemblies, including fixed points.
  6. Show details of expansion joints, including showing direction of expansion and contraction.
  7. Show details of roof penetrations.
  8. Show insulation, cover board, and other substrate accessories, including orientation of boards and fastening patterns.
  9. Show details of connections to adjoining work.
- C. Coordination Drawings: Roof plans drawn to scale with coordinated details for penetrations and roof-mounted items. Show the following:
  1. Metal roof panel assembly and attachments.
  2. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, roof accessories, and items mounted on roof curbs.
- D. Samples for Verification Purposes: For each type of exposed finish required, prepared on samples of size indicated below:
  1. Metal Roof and Soffit Panels: 12 in (300 mm) long by actual panel width. Include fasteners, clips, battens, closures, and other metal roof panel accessories.
  2. Trim and Closures: 12 in (300 mm) long. Include fasteners and other exposed accessories.
  3. Accessories: 12 in (300 mm) long samples for each type of accessory.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
  - 1. Notice of Acceptance Reports: Submit valid Product Control Notice of Acceptance (NOA) issued by Miami-Dade County Building Code Compliance Office (BCCO) or equivalent evidence acceptable to authority having jurisdiction.
- C. Field Quality Control Reports: Written report of testing and inspection required by “Field Quality Control”.
- D. Manufacturer’s Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- E. Portable Roll-Forming Equipment Certificate: Issued by UL for equipment manufacturer's portable roll-forming equipment capable of producing panels that complies with UL requirements. Show expiration date no earlier than two months after scheduled completion of metal roof panel assembly.
  - 1. Submit certificates indicating recertification of equipment whose certification has expired during the construction period.
- F. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- G. Warranty: Sample of warranty.
  - 1. Provide manufacturer’s written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.

3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Insurance Certification: Assist Owner in preparing and submitting roof installation acceptance certification as necessary in connection with fire and extended-coverage insurance on roofing and associated work.
- C. Quality Standards:
1. Unless otherwise recommended by roofing system manufacturer, provide roofing system in accordance with recommendations of the NRCA "Roofing and Waterproofing Manual" for roofing type indicated.
  2. Metal Decking Substrate: Comply with FMG System Loss Prevention Data Standards 1-28 Wind Design, 1-29 Roof Deck Securement and Above Deck Roof Components and 1-31 Metal Roof Systems for attachment and anchorage of roof system to metal decking.
- D. Fire-Test-Response Characteristics: Provide roofing system materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: ASTM E 108, Class A, for application and roof slopes indicated.
- E. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing roofing panels for metal panel roof assemblies that comply with UL 580 for specified Class of wind-uplift resistance. Maintain UL certification of portable roll-forming equipment for duration of metal roof panel assembly work.
1. On-site Roll-Formed Metal roof panel assembly Installer Qualifications: Installer shall be authorized by portable roll-forming equipment manufacturer to fabricate and install metal roof panel assembly units required for this Project.
- F. Metal Roof Panel Assembly Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- G. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  2. Clean exposed faces of mock-up.
  3. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  4. Demonstrate the proposed range of aesthetic effects and workmanship.
  5. Protect accepted mock-up from the elements with weather-resistant membrane.



6. Obtain Architect's acceptance of mock-ups before starting fabrication.
  7. Maintain mock-ups during construction in an undisturbed condition as a standard for review of the completed Work.
  8. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
  9. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.
- H. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Comply with requirements of applicable Division 01 Sections.
1. Review methods and procedures related to roof deck construction and metal roof panel assemblies including, but not limited to, items listed for the Pre-Installation Conference.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  3. Record discussions, including decisions and agreements, and prepare report.
  4. Contractor shall record discussions of conference, including decisions and agreements reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage of roof decking.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.
- E. 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.

#### **1.10 PROJECT CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

#### **1.11 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- C. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of roof decks, purlins, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

#### **1.12 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written prorated Full System "Weathertightness" warranty signed by an authorized representative using manufacturer's standard form agreeing to repair or replace components of metal roof panel assembly that fail to remain weathertight, including leaks, or which exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.
  1. Warranty includes metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete roofing system.
  2. Warranty Period: 20 years from date of Substantial Completion.

- B. Installer's Warranty: Furnish installer's written warranty signed by an authorized representative using installer's standard form agreeing to repair or replace components of metal roof panel assembly that fail to remain weathertight, including leaks, or which exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.
1. Warranty includes metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete roofing system.
  2. Warranty includes roof edge flashings integral with metal roof panels as specified in Division 07 Section "Flashing and Sheet Metal".
  3. Warranty Period: 2 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
1. AEP Span.
  2. Architectural Building Components.
  3. Berridge Manufacturing Company.
  4. CENTRIA Architectural Systems.
  5. Englert, Inc.
  6. Firestone Metal Products, LLC. (UNA-CLAD).
  7. Follansbee Steel.
  8. MBCI; a division of NCI Building Systems, L. P.
  9. Petersen Aluminum Corporation.
  10. Revere Copper Products, Inc.
  11. Rheinzink America Inc.; RHEINSINK ProRoofing.
  12. Titanium Metals Corporation; Architectural Applications Group.
  13. Umicore Building Products USA Inc.; VM ZINC PLUS.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
1. Match existing.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## 2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and flashings shall remain watertight.
- B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Design Loads: Installed roofing system and base flashings shall withstand design loads including, but not limited to, requirements established by authorities having jurisdiction, applicable local building codes, and as indicated. Contractor shall obtain required design data and identify requirements accommodated on submittal drawings.
- D. Material Compatibility: Provide roofing system materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- E. Roofing System Design: Provide roofing systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure and external fire exposure.
- F. FMG Listing: Provide roofing system, base flashings, and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG Approvals markings.
  - 1. Fire/Windstorm Classification at Roof Corner and Perimeter Region: Class 1A-150.
  - 2. Fire/Windstorm Classification at Field of Roof: Class 1A-90.
- G. Energy Performance for Low Slope Roofs: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- H. Energy Performance: Provide roofing system that is listed on the DOE ENERGY STAR "Roof Products Qualified Product List" for low and steep-slope roof products.
- I. Energy Performance: Provide roofing system with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

## 2.4 METALLIC-COATED STEEL SHEET ROOF PANEL MATERIALS

- A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755 / A 755M.
  - 1. Provide one of the following:
    - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653 / A 653M, G90 (Z275) coating designation; structural quality.
    - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792 / A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.

2. Surface: Smooth and flat.
3. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Provide dry film thickness, primers, color coats and clear coats required to comply with performance requirements and warranty periods indicated.
    - 1) PVDF Fluoropolymer Finish: Fluoropolymer finish complying with AAMA 621 and containing not less than 70 percent PVDF resin by weight in color coat.
    - 2) FEVE Fluoropolymer Finish: Fluoropolymer finish complying with AAMA 621 and containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat..
    - 3) Selections: As scheduled or as indicated in Design Selections.
4. 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 mils (0.013 mm)**.

## 2.5 SUBSTRATE BOARDS

- A. Substrate Boards for Fire-Resistance: ASTM C 1396 / C 1396M, Type X, gypsum board with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges, 5/8 in (15 mm) thick.
- B. Substrate Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FMG 4470, designed for fastening substrate board to substrate.

## 2.6 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653 / A 653M, G90 (Z275) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Zee-Purlins: Z-shaped furring with slotted or nonslotted web, face flange of 1-1/4 in (32 mm), wall attachment flange of 7/8 in (21 mm), and depth required to fit insulation thickness indicated.
  1. Nominal Thickness: 0.053 in (16 gage) (1.34 mm).
- C. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

## 2.7 ROOF INSULATION AND ACCESSORIES

- A. General: Provide preformed roof insulation boards that comply with requirements of referenced standards, selected from manufacturer's standard sizes and thicknesses. Provide accessories recommended by insulation manufacturer for intended use and compatible with roofing.

1. Provide insulation thickness required to maintain minimum aged R-value of 30, or as indicated on the Drawings.
- B. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2, Grade 3, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core.
- C. Treated Wood Nailers and Cant Strips: As specified in Division 06 Section "Miscellaneous Rough Carpentry".
- D. Polyethylene Sheet Vapor Retarder: ASTM D4397, 6 mils (0.15 mm) thick.

## **2.8 ROOF COVER BOARDS**

- A. Roof Cover Boards: ASTM C 1177 / C 1177M, Type X.
  1. Description: Glass-mat faced exterior gypsum sheathing board specifically manufactured for use beneath roofing systems. Non-combustible moisture-resistant gypsum core with glass-mat facings; minimum 5/8 in (15 mm) thick. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
  2. Manufacturers and Products:
    - a. Georgia-Pacific Gypsum LLC; DensDeck Prime.
    - b. Temple-Inland, Inc.; GreenGlass Primed Roof Board.
    - c. USG; SECUROCK Gypsum-Fiber Roof Board.
- B. Screw Fasteners:
  1. Material Quality Standards: ASTM C 954, Type S-12.
  2. Product Description: Bugle head, self-drilling, self-tapping, stainless steel screws with Phillips-head recess of size, holding power, and other properties recommended by manufacturer; minimum 1 in (25 mm) long.

## **2.9 UNDERLAYMENT MATERIALS**

- A. Self-Adhering, High-Temperature Rubberized Asphalt Underlayment: Minimum 30 mils to 40 mils (0.76 mm to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
  3. Manufacturers and Products:
    - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
    - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Metal-Fab Manufacturing, LLC; MetShield.
    - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

4. Primer: Provided by underlayment manufacturer.
  5. Underlayment Sealing Tape: Provided by underlayment manufacturer.
- B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts, nonperforated.
- C. Slip Sheet: Building paper, 3 lb/100 sf (0.16 kg/sm) minimum, rosin sized; or manufacturer's other recommended slip sheet of type required for application.

## **2.10 STANDING-SEAM METAL ROOF PANEL SYSTEMS**

- A. General: Provide factory- or site-formed metal roof panel system designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for complete weathertight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan 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, and snapping panels together.
1. Basis of Design: Match Existing
  2. Material and Minimum Thickness:
    - a. Zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet, standard of manufacturer; 22 gage, 0.034 in (0.86 mm) nominal minimum thickness.
  3. Clips: Manufacturer's standard floating type to accommodate thermal movement, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, or stainless steel, compatible with metal roof panels, designed to meet wind uplift performance requirements.
  4. Panel Coverage: 16 in.
  5. Panel Height: 2 in.

## **2.11 FABRICATION**

- A. Fabricate and finish metal roof panels and accessories using manufacturer's standard procedures and processes as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide roof panel profile for full length of panel.
- C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within roof panel assembly.

## 2.12 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of accepted 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 accepted Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine roof decking to verify that structural substrate members and anchorages have been installed within required alignment tolerances.
- C. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
  - 1. Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 2. Bituminous Coating: Coat back side of roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.



### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Zee Purlin Framing: Zee purlins shall be installed perpendicular to roof slope and spaced according to metal roof panel manufacturer's written instructions to accommodate clip spacing. Securely attach flanges of zee purlin members to roof deck with screws spaced according to metal roof panel manufacturer's written instructions.
- C. Miscellaneous Framing: Install eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

### 3.4 INSULATION INSTALLATION

- A. Coordinate installing metal roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with insulation manufacturer's written instructions for installing roof insulation.
- C. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is **2 in (50 mm)** or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of **6 in (150 mm)** in each direction.
- D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding **1/4 in (6 mm)** with insulation. Cut and fit insulation within **0.25 in (6.25 mm)** of nailers, projections, and penetrations.
- E. Hold insulation in place between zee purlins.
- F. Polyethylene Sheet Vapor Retarder: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Repair tears or punctures immediately before concealment by other work.

### 3.5 ROOF COVER BOARD INSTALLATION

- A. General: Comply with FMG and metal roof panel assembly manufacturer's written instructions for installing roof cover boards. Securely attach roof cover boards to zee purlins with fasteners spaced in accordance with metal roof panel manufacturer's written instructions to meet requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
- B. Install roof cover boards over entire roof surface. Install boards with panel lengths oriented perpendicular to roof slope with edges centered over flanges of zee purlins, with edges and ends butted together. Offset joints of insulation below a minimum of 6 in (150 mm) in each direction.
- C. Fit boards tightly against abutting construction, except provide maximum 3/8 in (10 mm) setback where boards abuts structural elements or materials that may retain moisture.

- D. Install screws so screw heads bear tightly against board face but do not cut into facing.
- E. Coordinate installation of roof cover boards with underlayments so materials are installed in the sequence and manner that prevent exterior moisture from passing through completed assembly.

### **3.6 UNDERLAYMENT INSTALLATION**

- A. Self-Adhering, High-Temperature Rubberized Asphalt Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 in (150 mm) staggered 24 in (600 mm) between courses. Overlap side edges not less than 3-1/2 in (87 mm). Roll laps with roller.
  - 1. Apply over entire roof surface from eave to ridge.
  - 2. Roof perimeter for a distance up from eaves of 36 in (900 mm) beyond interior wall line.
  - 3. Valleys, from lowest point to highest point, for a distance on each side of 18 in (450 mm). Overlap ends of sheets not less than 6 in (150 mm).
  - 4. Rake edges for a distance of 18 in (450 mm).
  - 5. Hips and ridges for a distance on each side of 12 in (300 mm).
  - 6. Roof to wall intersections for a distance from wall of 18 in (450 mm).
  - 7. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 in (450 mm).
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels if required by metal roof panel manufacturer and install and follows:
  - 1. Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing materials and fabrications. Apply in shingle fashion to shed water, with lapped joints of not less than 2 in (50 mm). Apply slip sheet over underlayment before installing metal roof panels if required by metal roof panel manufacturer.
- C. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Flashing and Sheet Metal".

### **3.7 METAL ROOF PANEL INSTALLATION, GENERAL**

- A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
- B. General: Work under this Section may be either factory-fabricated, custom-fabricated, or on-site formed and fabricated as long as the installed assembly can be verified that it meets the specified performance requirements.
- C. Custom fabricate metal roof panel assembly to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions (panel width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate metal roof panel assembly and accessories at the shop to greatest extent possible.

- D. Fabricate on-site roll-formed metal roof panels with UL-certified, portable roll-forming equipment capable of producing roofing panels for metal panel roof assemblies that comply with UL 580 for wind-uplift resistance classification specified in "Quality Assurance" Article. Fabricate roll-formed metal roof panels according to equipment manufacturer's written instructions and to comply with details shown.
- E. Fabrication Tolerances: Fabricate metal roof panel assembly that is capable of installation to a tolerance of 1/4 in per 20 ft (6 mm per 6 m) on slope and location lines as indicated and within 1/8 in (3 mm) offset of adjoining faces and of alignment of matching profiles.
- F. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Pre-drill panels for fasteners.
  - 1. Point of Fixity: Fasten each panel along a single line of fixing located at ridge.
  - 2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.
- G. Install metal roof panels as follows:
  - 1. Commence metal roof panel installation and install minimum of 300 sf (27.8 sm) in presence of factory-authorized representative.
  - 2. Field cutting of metal panels by torch is not permitted.
  - 3. Install panels parallel with roof slope.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Provide metal closures at rake edges, rake walls, and each side of ridge and hip caps.
  - 6. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
  - 7. Install ridge and hip caps as metal roof panel work proceeds.
  - 8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.
  - 9. Install metal flashing to allow moisture to run over and off metal roof panels.
- H. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using metal roof panel assembly manufacturer's approved anchor clips and fasteners spaced according to written instructions.
- I. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
  - 1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
  - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants".

### **3.8 METAL ROOF PANEL SYSTEM INSTALLATION**

- A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners according to metal roof panel manufacturer's written instructions.
  - 1. Install clips to supports with self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

### **3.9 METAL SOFFIT PANEL INSTALLATION**

- A. In addition to complying with requirements in "Metal Roof Panel Installation, General" Article, install metal soffit panels to comply with requirements in this article.
- B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
  1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.
- C. Metal Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

### **3.10 ACCESSORIES 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.
- B. Flashing and Sheet Metal: As specified in Division 07 Section "Flashing and Sheet Metal".
- C. Gutters and Downspouts: As specified in Division 07 Section "Flashing and Sheet Metal".
- D. Snow Guards: As specified in Division 07 Section "Roof Accessories".
- E. Roof Curbs: As specified in Division 07 Section "Roof Accessories".
- F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### **3.11 ERECTION TOLERANCES**

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 in per 20 ft (6 mm per 6 m) on slope and location lines as indicated and within 1/8 in (3 mm) offset of adjoining faces and of alignment of matching profiles.

### **3.12 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

**3.13 CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**3.14 ARCHITECTURAL METAL FINISH SCHEDULE**

- A. Finish Color: Match Existing.

**END OF SECTION**

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**METAL ROOF**  
**PANELS**

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## SECTION 07 5013

### SINGLE-PLY MEMBRANE ROOFING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Single-ply membrane roofing system and supplementary items necessary for installation.

##### 1.2 ALLOWANCES

- A. Concrete Moisture Barrier Allowance: Include allowance to provide Concrete Moisture Barrier at concrete roof deck.
  - 1. If Concrete Moisture Barrier is provided, verify Vapor Retarder requirements with roofing system manufacturer.

##### 1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Roof Edge Regions: The following definitions from ANSI/SPRI ES-1 shall be applicable to this project:
  - 1. Roof Corner Region: Based on the following:
    - a. For buildings with mean roof height of 60 ft (18 m) or less, the corner region is a distance from the building corner that is 10 percent of the minimum building width or 40 percent of the building height at the eaves, whichever is smaller, but not less than 4 percent of minimum building width and not less than 3 ft (0.9 m).
    - b. For buildings with mean roof height greater than 60 ft (18 m), the corner region is a distance from the building corner that is 10 percent of the minimum building width but not less than 3 ft (0.9 m).
  - 2. Roof Perimeter: The section of the roof edge between corner regions as defined above. The edge condition includes the roof edge device (edge flashing or coping) and the nailers or other substrate to edge device is attached.
- C. TPO: Thermoplastic polyolefin.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

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- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
1. Show base flashings and membrane terminations.
  2. Show flat and sloped tapered insulation, including slopes.
  3. Show crickets and saddles, including slopes.
  4. Show roof plan showing orientation of membrane roofing and fastener spacing.
  5. Show insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  6. Show cold-applied adhesive pattern for insulation installation; typical pattern of a 100 square foot area.
  7. Include project specific details for typical and non-typical conditions.
- C. Samples for Verification Purposes: For the following products:
1. Roofing membrane, 12 in by 12 in (300 mm by 300 mm) square, of color specified, including side and end lap seam.
  2. Flashing sheets.
  3. Vapor retarder, 12 in by 12 in (300 mm by 300 mm) square.
  4. Roof insulation.
  5. Walkway pads.
  6. Termination bars.
  7. Fasteners of each type, length, and finish.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
1. Roofing manufacturer shall review and approve Shop Drawings in writing prior to submission.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- D. Concrete Roof Deck - Moisture Content Measurement: Submit recorded readings when requested.
1. Submit moisture content readings to roofing manufacturer.
- E. Substrate Surface Temperature Readings at Cold Fluid-Applied Insulation Adhesive: Submit recorded readings.
1. Submit surface temperature readings to roofing manufacturer.
- F. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.



1. Roofing manufacturer shall review and approve Shop Drawings in writing prior to submission.

G. Qualification Data:

1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

H. Warranty: Sample of warranty.

1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: To include in maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.

B. Installer Qualifications:

1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
3. Manufacturer Acceptance: Installer shall be certified, approved, licensed or acceptable to manufacturer to install products.

- C. Insurance Certification: Assist Owner in preparing and submitting roof installation acceptance certification as necessary in connection with fire and extended-coverage insurance on roofing and associated work.

D. Quality Standards:

1. Unless otherwise recommended by roofing manufacturer, provide roofing system in accordance with recommendations of the NRCA "Roofing and Waterproofing Manual" for roofing type indicated.
2. Comply with FMG System Loss Prevention Data Sheet 1-49 for attachment and anchorage of nailers, blocking, and other associated members for applicable wind zone for Project.
3. Comply with FMG System Loss Prevention Data Standards 1-28 and 1-28S for attachment and anchorage of roof insulation to metal decking.

- E. Fire-Test-Response Characteristics: Provide roofing system materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
  - 1. Exterior Fire-Test Exposure: ASTM E 108, Class A, for application and roof slopes indicated.
  - 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor (superintendent).
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
    - g. Review deck substrate requirements for conditions and finishes, including flatness, presence of moisture, and fastening.
    - h. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
    - i. Review governing regulations and requirements for insurance and certificates if applicable.
    - j. Review temporary protection requirements for roofing during and after installation.
    - k. Review roof observation and repair procedures after roofing installation.
  - 3. Record discussions, including decisions and agreements, and prepare report.

## **1.9 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 materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored 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.

## **1.10 PROJECT 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.

## **1.11 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **1.12 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written "Total Roofing System" warranty signed by an authorized representative using manufacturer's standard form, without monetary limitation (NDL), agreeing to repair or replace components of roofing system which exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.
  - 1. Warranty includes roofing, flashings, adhesives, sealants, insulation, fastener systems, cover board, substrate board, and other components of roofing system.
  - 2. Warranty includes roof edge flashings integral with roofing system as specified in Division 07 Section "Flashing and Sheet Metal".
  - 3. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 20 years from date of Substantial Completion.
- B. Installer's Warranty: Furnish installer's written warranty signed by an authorized representative using installer's standard form agreeing to repair or replace components of roofing system which exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.

1. Warranty includes roofing, flashings, counterflashings, adhesives, sealants, insulation, fastener systems, cover boards, substrate board, roofing accessories, and other components of roofing system.
2. Warranty includes roof edge flashings integral with roofing system as specified in Division 07 Section "Flashing and Sheet Metal".
3. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and base flashings shall remain watertight.
- B. Design Loads: Installed roofing system and base flashings shall withstand design loads including, but not limited to, requirements established by authorities having jurisdiction, applicable local building codes, and as indicated. Contractor shall obtain required design data and identify requirements accommodated on submittal drawings.
- C. Material Compatibility: Provide roofing system materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- D. Edge Systems Design: Provide edge systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to SPRI's "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems" ES-1.
- E. Roofing System Design: Provide roofing systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure and external fire exposure.

- F. FMG Listing: Provide roofing system, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a roofing system and that are listed in FMG Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG Approvals markings.
  - 1. Fire/Windstorm Classification at Roof Corner and Perimeter Region: Class 1A-150.
  - 2. Fire/Windstorm Classification at Field of Roof: Class 1A-90.
- G. Energy Performance for Low Slope Roofs: Provide roofing system with initial Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

## **2.4 SINGLE-PLY MEMBRANE ROOFING SYSTEM MATERIALS**

- A. TPO Membrane Roofing System: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
  - 1. Thickness: 60 mils (1.5 mm), nominal.
  - 2. Exposed Face Color: White.
  - 3. Exposed Face Color: As selected by Architect from manufacturer's standard colors.
  - 4. Manufacturers and Products:
    - a. Carlisle SynTec Inc.; Sure-Weld TPO.
    - b. Firestone Building Products Co.; UltraPly TPO.
    - c. Johns Manville, Inc.; JM TPO.
    - d. Carlisle SynTec Inc.; Sure-Weld FleeceBACK (FB) TPO.

## **2.5 SINGLE-PLY MEMBRANE ROOFING SYSTEM AUXILIARY MATERIALS**

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing membrane, of recommended thickness and compatible with roofing membrane, of same color as roofing membrane, and appropriate for Project roofing application.
- C. Coated Metal Flashing: Manufacturer's standard coated galvanized sheet metal (G90) flashing, minimum 24 gage, of same color as roofing membrane.
- D. Pipe / Stack Flashing: Pre-molded flexible membrane pipe collar with aluminum ring bonded to base as recommended by roofing system manufacturer.
- E. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Termination Bars: ASTM A 666, Type 304 formed stainless steel or extruded alloy 6063 aluminum bars; 2 types, one flat and one flat with upper flange shaped to receive sealant, locations as indicated; 1 in by 1/8 in (25 mm by 3 mm) thick; predrilled at 8 in (200 mm) centers; with corrosive resistant fasteners. No plastic bars allowed.

- H. Miscellaneous Accessories: Provide pourable sealers, preformed inside and outside corner sheet flashings, in-seam sealants, termination reglets, cover strips, and other accessories.
  - 1. All fasteners, anchors, nails, straps, bars and other concrete or wood fasteners shall be stainless steel.
- I. Seaming Material: Manufacturer's standard splicing adhesive and splice cleaner or primer and splice tape with release film.
- J. Lap Sealant: Manufacturer's standard single-component sealant, color to match roofing membrane.
- K. Sealant Pockets (aka Pitch Pans) at Roof Penetrations: Sealant pockets (aka pitch pans) at roofing penetrations are not allowed and will be considered non-conforming work. Refer to drawings for allowable penetration details.

## **2.6 CONCRETE MOISTURE BARRIER**

- A. Concrete Moisture Barrier Treatment: Products and systems formulated to reduce moisture vapor transmission and surface alkalinity from concrete substrates prior to installation of roofing materials. Concrete moisture barrier shall be recommended and approved in writing by roofing system manufacturer.

## **2.7 SUBSTRATE BOARDS FOR FIRE RESISTANCE**

- A. Substrate Boards for Fire-Resistance: Select one of the following:
  - 1. Gypsum Substrate Board: ASTM C 1396 / C 1396M, Type X, gypsum board with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges, 5/8 in (15 mm) thick.
  - 2. Glass-Faced Exterior Substrate Board: ASTM C 1177 / C 1177M, Type X, glass-mat, water-resistant exterior gypsum sheathing board specifically manufactured for use beneath roofing systems, 5/8 in (15 mm) thick.
    - a. Manufacturers and Products:
      - 1) Georgia-Pacific Gypsum LLC; DensDeck FireGuard Prime.
  - 3. Exterior Gypsum Substrate Board: ASTM C 1278 / C 1278M, Type X, exterior gypsum sheathing board specifically manufactured for use beneath roofing systems. Non-combustible, cellulosic-fiber-reinforced, moisture-resistant gypsum core, 5/8 in (15 mm) thick.
    - a. Manufacturers and Products:
      - 1) USG; SECUROCK Gypsum-Fiber Roof Board.

## **2.8 VAPOR RETARDER**

- A. Vapor Retarder: 40 mil composite self-adhesive vapor barrier composed of SBS modified bitumen and laminated film.

1. Basis of Design: Carlisle Syntec Systems; 725TR Air and Vapor Barrier/Temporary Roof.
  2. Basis of Design: Sika Sarnafil; Sarnavap 32 self Adhered.
  3. Basis of Design: As recommended by sheet membrane roofing system manufacturer.
- B. Vapor Retarder Substrate Board: Same product as roof cover board, 1/2 in (12 mm) thickness, specified elsewhere in this Section.

## **2.9 ROOF INSULATION AND ACCESSORIES**

- A. Insulation Board at Lightweight Insulating Concrete Substrate: Refer to Division 03 Section "Lightweight Insulating Concrete" for insulation board embedded in concrete slurry.
- B. General: Provide preformed roof insulation boards that comply with requirements of referenced standards, selected from manufacturer's standard sizes and of thicknesses. Provide accessories recommended by insulation manufacturer for intended use and compatible with roofing membrane.
1. Provide insulation thickness required to maintain minimum aged R-value as indicated on the Drawings.
  2. Insulation board thickness of individual insulation layers to be 2 in (50 mm) maximum.
  3. Insulation board size to be 4 ft by 4 ft (1.22 m by 1.22 m) maximum.
  4. Provide factory, tapered insulation boards where indicated for sloping to drain. Fabricate with 1/4 in (6 mm) per 12 in (300 mm) (1:48) taper, unless otherwise indicated.
  5. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- C. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, Type II, Class 2, Grade 2, (20 psi compressive strength, product shall have glass-fiber mat on both major surfaces.
- D. Cold Fluid-Applied Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Bead-applied, low-rise, two-component urethane adhesive.
    - a. Basis of Design (Product Standard): OMG Inc.; Olybond 500.
- E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- F. Treated Wood Nailers: As specified in Division 06 Section "Miscellaneous Rough Carpentry".

## **2.10 ROOF ACCESSORIES**

- A. Treated Wood Nailers: As specified in Division 06 Section "Miscellaneous Rough Carpentry".

## **2.11 ROOF COVER BOARDS**

- A. Horizontal Roof Cover Boards: Glass-Mat Faced Exterior Gypsum Sheathing Board.

1. Material Quality Standard: ASTM C 1177 / C 1177M.
  2. Description: Glass-mat faced exterior gypsum sheathing board specifically manufactured for use beneath roofing systems. Non-combustible moisture-resistant gypsum core with glass-mat facings. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
  3. Manufacturers and Products:
    - a. Georgia-Pacific Gypsum LLC; DensDeck Prime.
  4. Thickness: Minimum 1/4 in (6 mm); or as required to meet performance requirements.
- B. Horizontal Roof Cover Boards: Exterior Gypsum Sheathing Board.
1. Material Quality Standard: ASTM C 1278 / C 1278M.
  2. Description: Exterior gypsum sheathing board specifically manufactured for use beneath roofing systems. Non-combustible, cellulosic-fiber-reinforced, moisture-resistant gypsum core. Provide in maximum lengths and widths available that will minimize short-edge-to-short-edge butt joints and to correspond to support system indicated.
  3. Manufacturers and Products:
    - a. USG; SECUROCK Gypsum-Fiber Roof Board.
  4. Thickness: Minimum 1/4 in (6 mm); or as required to meet performance requirements.
- C. Vertical Cover Boards (Back of Parapet): As specified in Division 06 Section "Exterior Gypsum Sheathing".

## **2.12 FLEXIBLE WALKWAYS**

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 in (5 mm) thick, as recommended by roofing system manufacturer.

## **2.13 FLASHING AND SHEET METAL**

- A. Flashing and Sheet Metal: Refer to Division 07 Section "Sheet Metal Flashing and Trim".

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions, including concrete moisture content, have been corrected in a manner complying with roofing manufacturer recommendations and Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
  1. Verify that roof openings and penetrations are in place and set and braced and that roof drains 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 thickness of insulation.
  3. Metal Decking Substrates:
    - a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Roof Decking".
  4. At cast-in-place concrete or composite metal deck substrates:
    - a. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
    - b. Concrete Moisture Testing: Perform one or both of the following tests as recommended by roofing manufacturer. Proceed with installation only after concrete substrates pass testing.
      - 1) Relative Humidity Test: As recommended by NRCA, perform moisture test using in situ probes in accordance with ASTM F 2170. Concrete to be drilled and probes inserted for minimum of 48 hours. Proceed with installation only after concrete substrates have a maximum 75 percent relative humidity level measurement or at a level as recommended by roofing manufacturer. Perform 3 moisture tests for first 1000 sf (92.9 sm) of concrete substrate scheduled to receive roofing and 1 test for each additional 1000 sf (92.9 sm) or fraction thereof.
      - 2) Manufacturer's Concrete Moisture Test: Roofing manufacturer's standard moisture test with measurements or results acceptable to roofing manufacturer.
    - c. Concrete Moisture Barrier: For concrete substrates not meeting moisture test standards specified above, install concrete moisture barrier to concrete substrate in accordance with manufacturer's written instructions.
    - d. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Substrate Surface Temperature at Cold Fluid-Applied Insulation Adhesive: Confirm that concrete substrate or substrate board surface temperature is a minimum 50 deg F (10 deg C) prior to application of adhesive.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- C. 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.
- D. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### **3.4 SUBSTRATE BOARDS FOR FIRE RESISTANCE - INSTALLATION**

- A. Install substrate boards with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
  - 1. Fasten substrate boards to top flanges of steel deck according to recommendations in FMG Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

### **3.5 VAPOR RETARDER INSTALLATION**

- A. Vapor Retarder Substrate Board: Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
  - 1. Fasten substrate boards to top flanges of steel deck according to recommendations in FMG Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
- B. Vapor Retarder: Install according to roofing system manufacturer's written instructions.
- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into single-ply roofing.

### **3.6 INSULATION INSTALLATION**

- A. General: Comply with FMG and roofing system manufacturer's written instructions for installing roof insulation. Secure insulation according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
- B. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 in (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 in (150 mm) in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 in (6 mm) with insulation. Cut and fit insulation within 1/4 in (6 mm) of nailers, projections, and penetrations.
- G. Cast-in-Place Concrete or Composite Metal Deck Substrate:
  - 1. Install and adhere base layer of insulation to substrate in a layer of cold fluid-applied adhesive.
  - 2. Install subsequent layers of insulation in a layer of cold fluid-applied adhesive.
- H. Steel Roof Deck Substrate: Provide the following method according to performance criteria requirements for specified Windstorm Resistance Classification:
  - 1. Mechanically Fastened and Adhered Insulation: Install base layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type. Install subsequent layers of insulation in a layer of cold fluid-applied adhesive.
- I. Substrate Board Substrate: Install and adhere base layer of insulation to substrate board in a layer of cold fluid-applied adhesive. Install subsequent layers of insulation in a layer of cold fluid-applied adhesive.

### **3.7 ROOF COVER BOARDS INSTALLATION**

- A. General: Comply with FMG and roofing system manufacturer's written instructions for installing roof cover boards. Secure roof cover boards to insulation substrate according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
- B. Install roof 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 in (150 mm) in each direction. Loosely butt roof cover boards together.
  - 1. Provide following fastening method according to performance criteria requirements for specified Windstorm Resistance Classification:
    - a. Adhere roof cover boards to insulation substrate in a layer of cold fluid-applied adhesive.
      - 1) Score boards, if necessary, to conform to substrate irregularities. Comply with manufacturer's installation recommendations to insure proper adhesion and adhesive set.

- C. Secure roof cover boards to insulation to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturer's written instructions.

### **3.8 SINGLE-PLY MEMBRANE ROOFING SYSTEM INSTALLATION; GENERAL REQUIREMENTS**

- A. Install roofing membrane according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow it to relax before installing.
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- D. Coordinate installation of roofing system so insulation and other components of roofing system not intended for permanent exposure are not subjected to extreme heat, precipitation, or left uncovered at the end of the workday or when inclement weather is forecast.
  - 1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a temporary protection layer set in roofing adhesive with joints and edges sealed.
  - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
  - 3. Remove and discard temporary seals before beginning work on adjoining roofing.
- E. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by roofing system manufacturer. Stagger end laps. Apply roofing membrane with side laps shingled with slope of roof deck.
- F. Securely attach and tie-in roofing membrane at roof drains and piping / stack flashings in accordance with roofing system manufacturer's written instructions.

### **3.9 FULLY ADHERED SINGLE-PLY MEMBRANE ROOFING INSTALLATION**

- A. Adhere sheet membrane over area to receive roofing and install according to roofing system manufacturer's written instructions.
  - 1. Ensure membrane is continuously adhered to substrate without voids, holidays, and unbonded membrane.
- B. Adhere roofing membrane at terminations, penetrations, corners, and perimeter of roofing.
- C. Seams:
  - 1. TPO Applications: Clean seam areas, overlap roofing membrane, and heat weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
    - a. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.

- b. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
- c. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

### **3.10 BASE FLASHING INSTALLATION**

- 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 bonding adhesive to seam area of flashing.
- C. Seams:
  - 1. TPO Applications: Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Heat weld side and end laps to ensure a watertight seam installation.
- D. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### **3.11 WALKWAY INSTALLATION**

- A. Flexible Walkways: Install flexible walkway products at locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### **3.12 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Cold Fluid-Applied Insulation Adhesive Manufacturer's Inspection: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Test Cuts: The cold fluid-applied insulation adhesive manufacturer shall perform field quality control test cuts of the cold fluid-applied insulation adhesive installation.
- C. Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control, including infrared inspections on installed roof assemblies. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.

1. Infrared Inspection: Where infrared survey indicates moisture intrusion, wet insulation and damaged or deficient materials or construction shall be replaced in a manner to provide watertight and specified wind uplift resistant construction, and maintain the roof system warranty.

### **3.13 REPAIR, CLEANING, AND PROTECTION**

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION**

## SECTION 07 6200

### SHEET METAL FLASHING AND TRIM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Flashing and sheet metal including assemblies listed below along with supplementary items necessary for installation:
1. Reglets with counterflashing.
  2. Roof-drainage sheet metal fabrications.
  3. Steep-slope roof sheet metal fabrications.
  4. Embedded flashing.
  5. Equipment support flashing.
  6. Overhead-piping safety pans.
- B. Related Requirements:
1. Refer to Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
  2. Refer to Division 7 Section for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

##### 1.2 DELEGATED ENGINEERING REQUIREMENTS FOR COPINGS AND GRAVEL GUARDS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.
- B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
- C. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- D. Coordination of Work:
1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be

included in the Work at no additional cost to Owner.

2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. 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 special conditions.
  9. Include details of connections to adjoining work.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification Purposes: Submit for items listed below; provide samples made from 12 in (300 mm) lengths of full-size components including fasteners, cover joints, accessories, and attachments.
  1. Sheet Metal Flashing: 12 in (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 in (300 mm) long and in required profile. Include fasteners and other exposed accessories.
  3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Delegated Engineering Calculations: Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.



- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- D. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- E. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- F. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

### **1.5 CLOSEOUT SUBMITTALS**

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

### **1.6 QUALITY ASSURANCE**

- A. Manufacturer/Fabricator Qualifications: Manufacturer/shop-fabricator with not less than 5 years experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities, and personnel to produce required Work.
  - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be NRCA listed or shall provide other evidence acceptable to Architect as able to fabricate required details as tested and approved.
- B. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- C. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.

### **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

1. Participants:
  - a. Architect.
  - b. Contractor, including superintendent.
  - c. Installer, including project manager and supervisor.
  - d. If requested, Manufacturer's qualified technical representative.
  - e. Installers of other construction interfaced with Work.
  
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
  - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  
3. Record discussions, including decisions and agreements, and prepare report.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
  
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
  
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing materials and fabrications away from uncured concrete and masonry.
  
- D. 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 PROJECT CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit flashing and sheet metal work to be performed according to manufacturer's written instructions and warranty requirements.
  
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.10 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. 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.
- C. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

## **1.11 WARRANTY**

- A. Installer's Warranty: Furnish installer's written warranty signed by an authorized representative using installer's standard form agreeing to repair or replace components of all sheet metal flashing assemblies that exhibit defects in materials or workmanship within specified warranty period. "Defects" is defined to include, but not limited to, deterioration or failure to perform as required.
  - 1. Warranty Period: 2 years from date of Substantial Completion.
- B. Factory Applied Finish Warranty: Furnish manufacturer's written warranty signed by an authorized representative using manufacturer's standard form agreeing to repair finish or replace work which exhibits finish defects. "Defects" is defined to include but not limited to deterioration or failure of finish to perform as required.
  - 1. Coverage includes but is not limited to the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: Manufacturer shall warrant the installation to be free from finish defects for a period of 20 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
  - 1. Manufacturers:
    - a. Cheney Flashing Company.
    - b. Fry Reglet Corporation.
    - c. Hickman Company, W. P.
    - d. Keystone Flashing Company, Inc.
    - e. MM Systems Corporation.
    - f. Petersen Aluminum Corporation.

## **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## **2.3 PERFORMANCE REQUIREMENTS**

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Design Loads: Installed sheet metal flashing materials and fabrications shall withstand design loads including, but not limited to, requirements established by authorities having jurisdiction, applicable local building codes, and as indicated. Contractor shall obtain required design data and identify requirements accommodated on submittal drawings.
- C. Material Compatibility: Provide flashing and sheet metal materials that are compatible with one another and specified roofing system under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.
- D. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- E. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

## **2.4 SHEET METALS**

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish:
    - a. Two-Coat Fluoropolymer: AAMA 2605. 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. Color: As scheduled or as indicated in Drawings.
  3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 , dead soft, fully annealed; with smooth, flat surface.
1. Finish: 2D (dull, cold rolled).
- D. Metallic-Coated Steel Sheet:
1. Zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation.
  2. Aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A 755/A 755M.
  3. Exposed Finish:
    - a. Surface: Smooth, flat.
    - b. Exposed Coil-Coated Finish:
      - 1) Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  4. Color and Gloss: As scheduled or as indicated in Drawings.
  5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

## **2.5 UNDERLAYMENT MATERIALS**

- A. Material Compatibility: Provide underlayment materials that are compatible with substrates and specified roofing system under conditions of service and application required, as demonstrated by manufacturer based on testing and field experience.
- B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.
  3. SBS-Modified Asphalt Adhesive based Manufacturers and Products:
    - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.

- b. Grace Construction Products, a unit of W. R. Grace & Co.; Ice and Water Shield HT.
  - c. Henry Company; Blueskin PE200 HT.
  - d. Metal-Fab Manufacturing, LLC; MetShield.
  - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
- 4. Butyl Adhesive based Manufacturers and Products:
  - a. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
- 5. Primer: Provided by underlayment manufacturer.
- 6. Underlayment Sealing Tape: Provided by underlayment manufacturer.
- C. Slip Sheet: If recommended by manufacturer to separate sheet metal from underlayment; rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

## 2.6 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Manufacturer's recommended 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.
  - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
  - 4. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
  - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
  - 2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.
- D. Rubberized-Asphalt Flexible Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 in (1.02 mm).
  - 1. Manufacturers and Products:

- a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
  - b. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
  - c. Grace Construction Products, W.R. Grace & Co.-Conn.; Perm-A-Barrier Wall Flashing.
  - d. Heckmann Building Products, Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
  - e. Hohmann & Barnard, Inc.; Textroflash.
  - f. W.R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
  - g. Polyguard Products, Inc.; Polyguard 400.
2. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- E. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 in (12 mm) wide and 1/8 in (3 mm) thick.
- F. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- G. Sealant for Use at Concealed Joints: Contractor's option, one of the following:
- 1. Butyl: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
  - 2. Silicone: ASTM C 920, single-component, neutral cure silicone sealant.
- a. Basis of Design: Dow Corning; 758 Silicone Weather Barrier Sealant.
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, or cold-applied asphalt emulsion complying with ASTM D 1187; compounded for 15 mils (0.4 mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

## **2.7 FABRICATION, GENERAL**

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
- 1. 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.
  - 2. Obtain field measurements for accurate fit before shop fabrication.
  - 3. 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.
  - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 in in 20 ft (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8 in (3 mm) offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 ft (3 m) with no joints within 24 in (600 mm) of corner or intersection.
- D. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- 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. Soldered Seams: Fabricate nonmoving seams with flat-lock seams except at corners. Rivet joints where necessary for strength
  - 1. Corners: Shop fabricate, factory mitered corners with continuously welded or soldered seams. Fabricate corners with no joints within 24 in (600 mm) of corner or intersection.
- H. Copings 12" Wide or Less: Form butted joints with expansion space and 12 in (300 mm) wide, concealed backup plate with double sealant on each side of joint.
- I. Copings Over 12" Wide: Form joints of intermeshing hooked flanges, not less than 1 in (25 mm) deep, filled with sealant concealed within joints.
- J. Do not use graphite pencils to mark metal surfaces.

## **2.8 SHEET METAL FLASHING AND TRIM**

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
  - 1. Fabricate from the Following Materials, minimum thickness as indicated unless required otherwise to meet performance requirements.
    - a. Galvanized Steel: 0.028 in (0.7 mm) thick.
  - 2. Corners: Factory mitered, mechanically clinched and sealed watertight.
  - 3. Joints: Lapped, double seal with sealant.
  - 4. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  - 5. Accessories:
    - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.



- b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
6. Finish: With manufacturer's standard color coating, unless indicated otherwise.

## **2.9 ROOF-DRAINAGE SHEET METAL FABRICATIONS**

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96 in (2400 mm) long sections. Furnish flat-stock gutter brackets and 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. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners:
1. Gutter Profile: As indicated on Drawings, according to cited sheet metal standard.
  2. Accessories: Wire-ball downspout strainer, Valley baffles.
  3. Gutters with Girth up to 15 in (375 mm): Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.
    - a. Aluminum: 0.032 in (0.8 mm) thick.
    - b. Galvanized Steel: 0.028 in (0.7 mm) thick.
    - c. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
  4. Gutters with Girth 16 to 20 In (400 to 500 mm): Fabricate from the following materials:
    - a. Aluminum: 0.040 in (1.0 mm) thick.
    - b. Galvanized Steel: 0.028 in (0.7 mm) thick.
    - c. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
  5. Corners: Factory mitered, mechanically clinched and sealed watertight.
  6. Joints: Lapped, double seal with sealant.
- B. Downspouts: Fabricate rectangular, unless indicated otherwise, downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows. Size as recommended by SMACNA.
1. Hanger Style: As indicated, according to SMACNA's "Architectural Sheet Metal Manual."
  2. Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.
    - a. Aluminum: 0.032 in (0.8 mm) thick.
    - b. Galvanized Steel: 0.028 in (0.7 mm) thick.
    - c. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
- C. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
1. Aluminum: 0.040 in (1.0 mm) thick.
  2. Corners and Joints: Factory mitered, solder or weld watertight.

## **2.10 LOW-SLOPE ROOF SHEET METAL FABRICATIONS**

- A. Roof Expansion-Joint Covers, 2 In (50 mm) and Less: Fabricate cap type expansion cover with continuous flanges to hold cap and serve as counter flashing. Form section not to exceed 12 ft (3.6 m) in length and joint cap sections by standing seams held in place by cleats. Shop fabricate interior and exterior corners. Fabricate from the following materials, minimum

thickness as indicated unless required otherwise to meet performance requirements.

1. Aluminum: 0.050 in (1.25 mm) thick.
2. Galvanized Steel: 0.034 in (0.86 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.034 in (0.8 mm) thick.
4. Joint Style: Standing seam and seal with sealant.
5. Corners: Factory mitered and mechanically clinched and sealed watertight.
6. Joints: Standing seam, seal with sealant.

B. Manufactured Roof Expansion Joint Cover Systems, 2 in (50 mm) and Greater:

1. Refer to Division 07 Section "Expansion Control" for manufactured roof expansion joint covers.

C. Counterflashing: Manufactured units of heights to overlap top edges of base flashings by 4 in (100 mm) and in lengths not exceeding 12 ft (3.6 m) designed to snap into through-wall-flashing receiver and compress against base flashings with joints lapped. Shop fabricate interior and exterior corners. Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.

1. Aluminum: 0.032 in (0.8 mm) thick.
2. Galvanized Steel: 0.028 in (0.7 mm) thick.
3. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
4. Corners: Factory mitered and mechanically clinched and sealed watertight.
5. Joints: Lapped, double seal with sealant.

D. Flashing Receivers: Fabricate from same materials as counterflashing.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 in (0.7 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.

## 2.11 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Valley Flashing: Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.

1. Copper: 16 oz./sq. ft. (0.55 mm thick) .
2. Stainless Steel: 0.025 in (0.64 mm) thick.
3. Galvanized Steel: 0.028 in (0.7 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
5. Joints: Lapped, double seal with sealant.

B. Drip Edges: Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.

1. Copper: 16 oz./sq. ft. (0.55 mm thick) .
2. Stainless Steel: 0.025 in (0.64 mm) thick.
3. Galvanized Steel: 0.028 in (0.7 mm) thick.
4. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
5. Joints: Lapped, double seal with sealant.

C. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.

1. Copper: 16 oz./sq. ft. (0.55 mm thick) .
  2. Stainless Steel: 0.025 in (0.64 mm) thick.
  3. Galvanized Steel: 0.028 in (0.7 mm) thick.
  4. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
- D. Counterflashing: Shop fabricate with factory mitered and continuously welded corners, seal watertight. Fabricate from the following materials, minimum thickness as indicated unless required otherwise to meet performance requirements.
1. Galvanized Steel: 0.028 in (0.7 mm) thick.
  2. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.
  3. Joints: Lapped, double seal with sealant.
- E. Flashing Receivers: Fabricate from same materials as counterflashing.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 in (0.7 mm) thick.
  2. Aluminum-Zinc Alloy-Coated Steel: 0.028 in (0.7 mm) thick.

## **2.12 MISCELLANEOUS SHEET METAL FABRICATIONS**

- A. Equipment Support Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 in (0.7 mm) thick.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Stainless Steel: 0.025 in (0.64 mm) thick.
  2. Galvanized Steel: 0.040 in (1.0 mm) thick.
- C. Miscellaneous Flashings:
1. Fabricate to cross section indicated with clips and accessories required for secure watertight installation. Meet recommendations of SMACNA for fabrication details and metal thicknesses.
  2. Not-Exposed to Public View: Fabricate from the following materials:
    - a. Galvanized Steel: 0.028 in (0.7 mm) thick.
  3. Concealed from View by other Construction: Fabricate from the following materials:
    - a. Stainless Steel: 0.025 in (0.64 mm) thick.

## **2.13 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted 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.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
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.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Pitch Pockets (aka Pitch Pans) at Roof Penetrations: Pitch pockets (aka pitch pans) at roofing penetrations are not allowed and will be considered non-conforming work. Refer to the drawings for allowable roof penetration details.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 UNDERLAYMENT INSTALLATION**

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 in (150 mm) staggered 24 in (600 mm) between courses. Overlap side edges not less than 3-1/2 in (87 mm). Roll laps and edges with roller. Cover underlayment within 14 days.
- B. If recommended by manufacturer, apply slip sheet, wrinkle free, before installing sheet metal flashing and trim.

### **3.5 SHEET METAL FLASHING AND TRIM INSTALLATION**

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective

coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
    - a. Provide uniform, neat seams with minimum exposure of solder and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Space cleats not more than **12 in (300 mm)** apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  5. Torch cutting of sheet metal flashing and trim is not permitted.
  6. 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 and stainless-steel 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.
  3. Asphalt Roofing Cement: Bed flanges in thick coat of asphalt roofing cement where required by manufacturer of sheet metal flashing materials and fabrications for waterproof performance.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. When ambient temperature at time of installation is between 40 deg F and 70 deg F (4 deg C and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- 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. Concealed Sealant Joints: Use sealant-filled joints at lap joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher

ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Exposed Sealant Joints: Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 in (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

- H. Rivets: Rivet joints in uncoated metals where necessary for strength.

### **3.6 ROOF-DRAINAGE SYSTEM INSTALLATION**

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

- B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous cleat.
3. Anchor gutter with gutter brackets or straps spaced not more than 30 in (750 mm)] apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 ft (15.24 m) apart. Install expansion-joint caps.

- C. Downspouts: Join sections with 1-1/2-in (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 in (25 mm) from walls. Locate hangers at top and bottom and at approximately 60 in (1500 mm) o.c.
2. Terminate downspouts as indicated on Drawings.
  - a. Provide elbows at base of downspout to direct water away from building.
  - b. Connect downspouts to underground drainage system.

- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.

- E. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  - 1. Exterior Wall: Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.
  - 2. Exterior Wall and Conductor Head: Loosely lock front edge of scupper with conductor head.
  - 3. Solder or 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 in (25 mm) below scupper or gutter discharge.
- G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 in (100 mm) in direction of water flow.

### **3.7 ROOF FLASHING INSTALLATION**

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
  - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate.
  - 2. Anchor interior leg of coping as indicated on Drawings.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 in (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 in (100 mm) over base flashing. Lap counterflashing joints minimum of 4 in (100 mm). Secure in waterproof manner by means of anchor and washer at 36 in (910 mm) centers unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with sealant and clamp flashing to pipes that penetrate roof.

### **3.8 REGLET AND COUNTERFLASHING INSTALLATION**

- A. General: Coordinate installation of reglets and counterflashings with installation of base flashings. Secure in a waterproof manner by means of anchor and washer at 36 in (900 mm) centers.

- B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 in (100 mm) over top edge of base flashings.
- C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 in (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 in (100 mm) and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

### **3.9 MISCELLANEOUS FLASHING INSTALLATION**

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

### **3.10 ERECTION TOLERANCES**

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 in in 20 ft (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8 in (3mm) offset of adjoining faces and of alignment of matching profiles.

### **3.11 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Touchup Painting: Clean abraded or damaged areas of shop paint finish and paint exposed areas with the same material used for shop painting. Touchup finish is to match undamaged finish and extend into retained adjoining finish in a manner that will minimize evidence of touchup.
- F. 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.

### **3.12 FINISH SCHEDULE**

- A. Steel Sheet Finishes:



1. Color and Gloss: Match color of adjacent building material, contingent upon approval by Architect.

B. Aluminum Sheet Finishes:

1. Color and Gloss: Match color of adjacent building material, contingent upon approval by Architect.

**END OF SECTION**

**18-01.01 WPMHC Expansion  
Childers Architect  
2019-12-06**

**SHEET METAL FLASHING  
AND TRIM**

**07 6200 - 20**

## SECTION 07 8446

### FIRE RESISTIVE JOINT FIRESTOPPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes firestopping systems for joints at perimeter and through smoke and fire-resistance-rated assemblies, and supplementary items necessary to complete their installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Include firestopping design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated. Distinguish between shop and field-assembled work.
  - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each firestopping system configuration for each type construction.
  - 2. Where Project conditions require modification of qualified testing and inspecting agency's tested system to suit a particular firestopping condition, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed firestopping systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Firestop System installation shall meet requirements of ASTM E 1966 and/or ANSI/UL 2079 tested and listed assemblies that provide fire-resistance ratings not less than that of the construction in which the joint occurs.
- C. Source Limitations: Obtain firestopping systems, for each kind of construction condition required, from a single manufacturer.
- D. Compatibility and Adhesion Testing: Manufacturer of fire stopping material shall be responsible for testing samples of materials that will contact or affect firestopping materials.
  - 1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of fill materials to joint substrates.
  - 2. Perform tests under environmental conditions replicating those that will exist during installation.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, obtain fire-resistant joint sealants manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
- E. Fire-Test-Response Characteristics: Provide firestopping systems that comply with the following requirements and those specified in "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency performing testing and follow-up inspection services for firestopping systems acceptable to authorities having jurisdiction.
  - 2. Fire Resistive Joint System: Provide materials that are identical to those tested according to UL 2079 or ASTM E 1966. Products shall have a flame spread rating of less than 25.
    - a. Where UL-classified fire-resistant joint sealants are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.
    - b. Safing Material: Provide materials that are identical to those tested according to ASTM E 84. Products shall have the following ratings:
      - 1) Flame Spread: Less than 15.
      - 2) Smoke Developed: 0.
    - c. System: Provide materials that are identical to those tested according to a modified ASTM E 119 test, where the furnace is modified to simulate a floor as it intersects with the wall. System shall have the following rating:
      - 1) Integrity Rating: 2 hours.
      - 2) F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
    - d. Where UL-classified perimeter fire-containment systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN or XHDG.

## **1.5 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.6 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.
- B. Environmental Limitations: Do not install firestopping systems when ambient or substrate temperatures are outside limits permitted by firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- C. Ventilate firestopping systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

## **1.7 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Notify Owner's inspecting agency at least seven days in advance of firestopping system installations; confirm dates and times on days preceding each series of installations.
- C. Do not cover up firestopping system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

## **PART 2 - PRODUCTS**

### **2.1 FIRESTOPPING, GENERAL**

- A. Acceptable Manufacturers: Manufacturer is "acceptable" if firestopping system has been tested and listed by UL or other testing and inspection agency acceptable to authorities having jurisdiction and manufacturer can evidence product compliance with requirements of the Contract Documents.
  - 1. FM Global: Manufacturer to provide firestopping products in compliance with FM Global requirements as indicated in "Quality Assurance" Article.
- B. Compatibility: Provide firestopping systems that are compatible with one another and the substrates forming openings, under conditions of service and application, as demonstrated by firestopping system manufacturer based on testing and field experience.
- C. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials. Use only components specified by firestopping system manufacturer and approved by the qualified testing and inspecting agency for firestopping systems indicated.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General: Provide firestopping systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gasses.

- B. Fire-Resistant Joint Sealants: Provide systems for sealing linear joints in fire resistive rated assemblies that have ratings with movement capabilities equaling or exceeding the fire resistance rating of construction which joint occurs, as determined by UL 2079 or ASTM E 1966.
- C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  - 1. 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. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
  - 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Joints, required for control of movement, at intersection between Rated Wall Assemblies and Nonrated Horizontal Assemblies: Provide joint firestopping with ratings determined by ASTM E 2837.

### **2.3 TOP-OF-WALL JOINT FIRESTOPPING**

- A. Safing Insulation: Semi rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders and complying with the following:
  - 1. ASTM C 612, Type 1A and 1B.
  - 2. Nominal density of 4 lb/cu. ft.
  - 3. ASTM E119 Fire rating indicated, but not less than 2 hours.
- B. Coating Material: Manufacturers standard fill material or spray applied product for sealing surface of safing insulation and adjacent construction against penetration of fire and smoke.
- C. Fire Resistive Sealants: Intumescent single-component, water based, high solids, elastomeric sealants. Nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant.

### **2.4 EDGE -OF-SLAB FIRESTOPPING**

- A. Safing Insulation: Semi rigid board insulation produced by combining slag-wool fibers with thermosetting resin binders and complying with the following:
  - 1. ASTM C 612, Type 1A and 1B.
  - 2. Nominal density of 4 lb/cu. ft.
  - 3. ASTM E119 Fire rating indicated, but not less than 2 hours.
- B. Coating Material: Manufacturers standard fill material or spray applied product for sealing surface of safing insulation and adjacent construction against penetration of fire and smoke.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions

### **3.2 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
  - 1. Remove foreign materials from surfaces of joints that could interfere with adhesion of firestopping.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping 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. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

### **3.3 INSTALLATION - GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
- C. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- D. Install fill materials for fire-resistant joint sealants by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### **3.4 INSTALLATION OF FIRE-RESISTANT JOINT SEALANTS**

- A. Comply with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
- D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begin. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

### **3.5 INSTALLATION OF FIRE SAFING PROTECTION**

- A. Top of Wall: Install safing insulation to fill gap between top of wall and floor slab above. Cut safing insulation 50 percent wider than gap to be filled to ensure compression fit.
- B. Edge of Slab: Install safing insulation to fill gap between edge of structural floor/roof slab and back of exterior wall on safing clips spaced as needed to support insulation but not further apart than 24 in (600 mm) o.c. unless not required by tested system. Cut safing insulation 50 percent wider than gap to be filled to ensure compression fit or install vertically as required by tested assembly.
- C. Install coating material or smoke seal compound to cover fill material and seal opening.

### **3.6 IDENTIFICATION**

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within **6 in (150 mm)** of joint edge so labels will be visible to anyone seeking to remove or penetrate joint 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 - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Tested System or Engineered Judgment Number.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### **3.7 FIELD QUALITY CONTROL**

- A. Where required, inspection of fire resistive joint firestopping shall be performed in accordance with ASTM E 2393, "Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers" or other recognized standard.



- B. Testing Agency: The Owner may employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.
1. Inspections shall include the following verifications:
    - a. Verify that proper specified firestopping system products and materials are used.
    - b. Verify installer's credentials and certification.
    - c. Verify that each firestopping system is installed in accordance with product manufacturer's latest published requirements.
    - d. Verify that firestopping system materials and installation comply with appropriate rating authorities' requirements.
    - e. Verify that firestopping system is installed in specified and/or indicated locations in rated assemblies.
  2. Do not proceed to enclose firestopping system installations with other construction until reports of examinations are issued.
  3. Where deficiencies are found, repair or replace firestopping system materials and products to bring deficient installation into compliance with specified requirements.

### **3.8 CLEANING**

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping system products and of products in which joints occur.
- B. Protect firestopping system components during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

**END OF SECTION**



## **SECTION 07 9200**

### **JOINT SEALANTS**

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

##### **1.1 SUMMARY**

- A. Section Includes: Joint sealants, backing materials, and supplementary items necessary for installation.

##### **1.2 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Samples for Initial Selection: Where specified to provide sealant colors from manufacturer's standard and custom selections, provide manufacturer's color charts consisting of strips of cured sealants showing full range of colors available for each product exposed to view.
- C. Samples for Verification Purposes: Samples for each kind and color of joint sealants in 1/2 in (12 mm) wide joints formed between two 6 in (150 mm) long strips of material matching appearance of exposed surfaces adjacent to joint sealants.

##### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control" Article.
- C. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- E. Warranties: Sample of warranties.
  - 1. Provide manufacturer's and installer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Mock-Ups: Before beginning Work of this Section, install joint sealants in mock-ups of the various assemblies specified in other Sections indicated to receive joint sealants specified in this Section. Mock-ups shall include each form of product and color required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
- C. Pre-Construction Compatibility and Adhesion Testing: Provide samples of joint substrate materials that will contact or affect urethane and silicone joint sealants to respective joint sealant manufacturers for following testing:
1. General Requirements: Test materials forming joint substrates and joint sealant backings for compatibility and adhesion with joint sealants.
  2. Test Method: Manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  3. Specimen Quantity: Provide not fewer than number of pieces required of each kind of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
  4. Reports: Interpret test results and certify reports indicating requirements for primers and substrate preparation needed for adhesion or for corrective measures including use of specially formulated primers.
- D. -Construction Stain Testing: Submit samples of joint substrate materials that will contact or affect urethane and silicone joint sealants to respective joint sealant manufacturers for following testing:
1. General Requirements: Test materials forming joint substrates for resistance to staining caused by joint sealants.
  2. Test Method: ASTM C 1248.
  3. Specimen Quantity: Provide not fewer than number of pieces required by testing laboratory of each kind of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
  4. Reports: Interpret test results and certify reports indicating if joint sealants stain substrate materials.

## 1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.

- c. Installer, including project manager and supervisor.
  - d. If requested, Manufacturer's qualified technical representative.
  - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## **1.6 PROJECT CONDITIONS**

- A. Ambient Conditions: Install joint sealants within range of ambient and substrate temperatures and moisture conditions as recommended by manufacturer. Protect substrates from environmental conditions that affect performance.
  - 1. Do not apply to a damp or wet substrate or during high humidity conditions including snow, rain, fog, or mist.
- B. Weather Conditions Limitation: Proceed with Work only when existing and forecasted weather conditions will permit installation according to manufacturer's instructions and warranty requirements.

## **1.7 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **1.8 WARRANTY**

- A. Manufacturer's Warranty for Urethane Sealants: Furnish manufacturer's written material warranty for a period of 5 years from date of Substantial Completion signed by an authorized representative using manufacturer's standard form agreeing to furnish materials required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
- B. Manufacturer's Warranty for Silicone Sealants: Furnish manufacturer's written material for a period of 20 years from date of Substantial Completion signed by an authorized representative using manufacturer's standard form agreeing to furnish materials required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

- C. Installer's Warranty: Furnish installer's written warranty for a period of 2 years from date of Substantial Completion signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Compatibility: Joint sealants, backings, and other related materials shall be 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.
- C. Volatile Organic Compounds (VOC) Content of Interior Sealants: Sealants and primers for use inside weatherproofing system shall comply with following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Elastomeric Sealants: 250 g/L.
  - 2. Primers for Non-Porous Substrates: 250 g/L.
  - 3. Primers for Porous Substrates: 775 g/L.
- D. Suitability for Contact with Food: Comply with authorities having jurisdiction for joints in repeated contact with food.
- E. Sealant Color: As scheduled or as indicated in Design Selections.

### **2.3 EXTERIOR ELASTOMERIC SEALANTS**

- A. Exterior Pourable Urethane Sealant:
  - 1. Product Quality Standard: ASTM C 920, Type M, Grade P, Class 25, Use T.
  - 2. Description: Multi-component, pourable, moisture curing, polyurethane sealant; rated for incline when used on sloped surfaces.
  - 3. Joint Movement Capability: Plus 25 percent, minus 25 percent.
  - 4. Primers: Product provided by sealant manufacturer if required by conditions.
  - 5. Manufacturers and Products:
    - a. BASF; MasterSeal SL 2 (Formerly Sonolastic SL 2).
    - b. Pecora Corp.; Urexpam NR-200.
    - c. Sika Corp., Construction Products Div.; Sikaflex 2c SL.
    - d. Tremco Commercial Sealants & Waterproofing; THC-900/THC-901 or Vulkem 445SSL.

B. Exterior Non-sag Silicone Sealant:

1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 50 or 100/50.
2. Description: Single component, non-sag, neutral cure, non-staining as determined by pre-construction stain testing, and non-bleeding, silicone sealant.
3. Joint Movement Capability:
  - a. Class 50: Plus 50 percent, minus 50 percent.
  - b. Class 100/50: Plus 100 percent, minus 50 percent.
4. Primers: Product provided by sealant manufacturer if required by conditions.
5. Manufacturers and Products:
  - a. Class 50:
    - 1) Dow Corning; 795 Silicone Building Sealant.
    - 2) Momentive Performance Materials, GE Silicones; Silpruf SCS2000.
    - 3) Pecora Corp.; 864NST.
    - 4) Sika Corp., Construction Products Div.; Sikasil WS-295.
    - 5) Tremco Commercial Sealants & Waterproofing; Spectrem 3.
  - b. Class 100/50:
    - 1) Dow Corning; 790 Silicone Building Sealant.
    - 2) Momentive Performance Materials, GE Silicones; Silpruf LM SCS2700.
    - 3) Pecora Corp.; 890NST.
    - 4) Sika Corp., Construction Products Div.; Sikasil WS-290.
    - 5) Tremco Commercial Sealants & Waterproofing; Spectrem 1.

## 2.4 INTERIOR ELASTOMERIC SEALANTS

A. Interior Non-sag Silicone Sealant:

1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 25.
2. Description: Single component, non-sag, moisture curing, silicone sealant specially formulated with fungicide for use in sanitary non-porous applications.
3. Manufacturers and Products:
  - a. Dow Corning; 786 Silicone Sealant.
  - b. Momentive Performance Materials, GE Silicones; Sanitary SCS1700.
  - c. Pecora Corp.; 898.
  - d. Sika Corp., Construction Products Div.; Sikasil GP
  - e. Tremco Commercial Sealants & Waterproofing; Tremsil 200.

B. Interior Non-sag Urethane Sealant:

1. Product Quality Standard: ASTM C 920, Type S, Grade NS, Class 25 or 35.
2. Description: Single component, non-sag, moisture curing, non-staining as determined by pre-construction stain testing if exposed, polyurethane sealant.
3. Joint Movement Capability: Plus 25 percent, minus 25 percent, or plus 35 percent, minus 35 percent.
4. Primers: Product provided by sealant manufacturer if required by conditions.
5. Manufacturers and Products:
  - a. BASF; MasterSeal NP 1 (Formerly Sonolastic NP 1).

- b. Pecora Corp.; Dynatrol I-XL.
- c. Sika Corp., Construction Products Div.; Sikaflex 1a or Sikaflex Textured Sealant.
- d. Tremco Commercial Sealants & Waterproofing; Dymonic or Vulkem 116.

C. Interior Non-sag Acrylic Latex Sealant:

- 1. Product Quality Standard: ASTM C 834, Type and Grade as required by conditions.
- 2. Description: Single component, non-sag, moisture curing, general purpose, paintable, siliconized acrylic latex sealant.
- 3. Joint Movement Capability: Plus 7.5 percent, minus 7.5 percent
- 4. Manufacturers and Products:
  - a. Pecora Corp.; AC 20+.
  - b. Tremco Commercial Sealants & Waterproofing; Tremflex 834.

D. Sprayed Foam Insulating Gap Filler:

- 1. Description: Low pressure, one-component, expanding, open-cell latex-based insulating foam gap filler; applied with professional hand-held dispensing gun; CFC and HCFC free.
- 2. Performance Requirements: Class 1 Fire-Retardant per ASTM E 84.
- 3. Manufacturers and Products:
  - a. Convenience Products; Touch N' Foam, Easy Fill Latex Foam Sealant.
  - b. DAP Products, Inc.; DAPtex Plus.

E. Acoustical Sealants: As specified in Division 09 Section "Gypsum Board Assemblies".

F. Fire Resistive Sealants: As specified in Division 07 Section "Fire Resistive Joint Firestopping".

**2.5 HIGH TEMPERATURE SILICONE SEALANT**

A. Exterior/Interior High-Temperature Silicone Sealant:

- 1. One-component non-slumping silicone sealant for sealing and bonding applications exposed to temperatures as high as **600 deg F (315 deg C)**.
- 2. Manufacturer and Product: Dow Corning; 736 Heat Resistant Sealant.

**2.6 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. Use open cell (Type O) sealant backing rod at interior line of sealant for double sealed condition unless otherwise recommended by sealant manufacturer.

B. Cylindrical Sealant Backings:

- 1. Product Quality Standard: ASTM C 1330, Type C, Type O, or Type B; as approved in writing by joint-sealant manufacturer for joint application indicated.
- 2. Description: Extruded polyethylene, polyurethane, or polyolefin in either closed cell structure (Type C), open cell structure (Type O), or bicellular structure with surface skin (Type B) as defined by ASTM Terminology C 717.
- 3. Size: Diameter approximately 25 percent larger than joint width, unless otherwise directed by manufacturer.



4. Manufacturers and Products:

a. Type C:

- 1) BASF; MasterSeal 920 (Formerly Sonneborn, Closed-Cell Backer Rod).
- 2) Nomaco Inc.; Green Rod or HBR.

b. Type O:

- 1) Backer Rod Mfg. Inc.; Denver Foam.
- 2) Nomaco Inc.; Foam-Pak II.

c. Type B:

- 1) BASF; MasterSeal 921 (Formerly Sonneborn, Soft Backer Rod).
- 2) Nomaco Inc.; Dual-Rod or Sof-Rod.

- 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.7 ACCESSORIES

- A. Cleaners for Non-porous 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 non-porous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- B. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Surfaces and Conditions: Examine substrate surfaces to receive products and systems and associated Work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting Work within a particular area will be construed as acceptance of surface conditions.

### 3.2 INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Cleaning of Joints: Clean out joints immediately before installing joint backings and sealants to comply with joint sealant manufacturer's written instructions and following requirements:
  - 1. Remove foreign material that could interfere with adhesion of joint sealant, including, but not limited to, 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.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean non-porous 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.
  - 5. Substrate material allowed by sealant's ASTM C 920 Use Classification.
- C. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer, or as indicated by prior experience, or as required by pre-construction compatibility and adhesion testing. 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.
- D. 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.

### 3.4 INSTALLATION

- A. Joint Sealant Backings: Install 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 backings.
  - 3. Remove absorbent sealant backings that have become wet or damaged before sealant application and replace with dry materials.
  - 4. Install bond-breaker tape behind sealants where backings are not used between sealants and backs of joints.
- B. Joint Sealants: Install at same time as backings using proven techniques that comply with following:
  - 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.

4. 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.
    - a. Remove excess sealant from surfaces adjacent to joints.
    - b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
    - c. Use masking tape to protect surfaces adjacent to recessed tooled joints.
  5. Install joint sealants in accordance with ASTM C 1193 as applicable to materials, applications, conditions indicated, and with the following profile configurations:
    - a. Fillet: Figure 5.
    - b. Bridge: Figure 6.
    - c. Butt: Figure 8A (concave tooling), generally hour-glass shape with 2:1 width-to-depth ratio.
- C. Sprayed Foam Insulating Gap Filler: Apply sprayed foam insulating gap filler within exterior wall assemblies using professional hand-held dispensing gun in accordance with manufacturer's written instructions.
1. Prior to installation of wall finish systems, apply sprayed foam insulating gap filler to gaps, cracks, cavities, openings, and voids in exterior wall back-up, including annular space around piping, ducts, conduits, wiring, and electrical outlets to seal off potential air drafts.
  2. After sprayed foam sealant is applied, make flush with face of adjacent wall by using method recommended by manufacturer.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Field Adhesion Testing: Before installation, field test urethane and silicone sealant adhesion to joint substrates as follows:
1. General Requirements:
    - a. Locate test joints where indicated or, if not indicated, as directed by Architect.
    - b. Conduct field tests for each kind of urethane and silicone sealants and joint substrates indicated.
    - c. Notify Architect 7 days in advance of dates and times when test joints will be erected.
  2. Test Frequency: Perform 1 test for each 1000 ft (300 m) of joint length thereafter or 1 test for each floor at each elevation.
  3. Test Methods: Joint sealant manufacturer's technical representative shall conduct following tests:

- a. When Joint Substrates are Identical: Test joint sealants according to ASTM C 1193, Method A (field-applied sealant joint hand pull tab) described below:
  - 1) Conduct one test and one additional test for each 1000 ft (300 m) of kind of joint sealant material and substrate conditions.
  - 2) Install 24 in (600 mm) long test specimens using same materials, methods for joint preparation, and joint sealant installation required for Work. Allow sealants to cure fully before testing.
  - 3) Make horizontal knife cut across width of sealant joint from one substrate to other substrate.
  - 4) Make 2 vertical cuts at both sides of substrates, downward starting at horizontal cut, approximately 3 in (75 mm) long.
  - 5) Grasp 3 in (75 mm) long piece of sealant tab firmly 1 in (25 mm) from its bonded edge and pull at not less than 90 degree angle.
  - 6) Substrate adhesion is acceptable if sealant tears cohesively within itself or elongates to a manufacturer determined extension value from 1 in (25 mm) gauge length before releasing from substrate adhesively.
  
- b. When Joint Substrates are Different: Test joint sealants according to ASTM C 1193, Method C (field-applied sealant joint hand pull flap) described below:
  - 1) Conduct one test and one additional test for each 1000 ft (300 m) of kind of joint sealant material and substrate conditions.
  - 2) Install 24 in (600 mm) long test specimens using same materials, methods for joint preparation, and joint sealant installation required for Work. Allow sealants to cure fully before testing.
  - 3) Make first horizontal knife cut across width of sealant joint from one substrate to other substrate.
  - 4) Make one vertical cut along one side of substrate, downward starting at horizontal cut, approximately 3 in (75 mm) long.
  - 5) Make second horizontal knife cut across width of sealant joint from one substrate to other substrate at opposite end of 3 in (75 mm) long first cut.
  - 6) Grasp 3 in (75 mm) long piece of sealant flap firmly and pull at not less than 90 degree angle.
  - 7) Substrate adhesion is acceptable if sealant tears cohesively within itself or elongates to a manufacturer determined extension value from 1 in (25 mm) gauge length before releasing from substrate adhesively.
  
4. Reports: Report which sealants and joint preparation methods resulted in optimum adhesion to joint substrates or whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each specimen. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory. Sealants failing to adhere to joint substrates during testing are not acceptable.

### 3.6 CLEANING

- A. In-Progress Cleaning: Remove excess sealant or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### **3.7 PROTECTION**

- A. General Requirements: Protect 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

### **3.8 JOINT SEALANT SCHEDULE**

- A. Exterior Elastomeric Sealant Applications:
  - 1. Exterior Pourable Urethane Sealant:
    - a. Moving joints in exterior concrete walks and drives.
  - 2. Exterior Non-sag Silicone Sealant:
    - a. Moving joints on exterior side of exterior walls.
    - b. Gaps between building materials and components created by items penetrating the primary drainage surface of the exterior building envelope.
    - c. Joints between dissimilar materials on exterior side of exterior walls.
- B. Interior Elastomeric Sealant Applications:
  - 1. Interior Non-sag Silicone Sealant:
    - a. Non-moving joints in moist or damp areas which are susceptible to mildew.
    - b. Non-moving joints in toilet rooms.
    - c. Non-moving joints in kitchens.
    - d. Non-moving joints in repeated contact with food.
  - 2. Interior Non-sag Urethane Sealant:
    - a. Building joints on interior side of exterior walls where joint movement is anticipated.
  - 3. Interior Non-sag Acrylic Latex Sealant:
    - a. Non-moving joints where another type of sealant is not otherwise specified or scheduled.
    - b. Minimal moving joints due to temperature change.
- C. Sprayed Foam Insulating Gap Filler Applications:
  - 1. Exterior non-moving gaps around windows, glazed aluminum walls, doors, and penetrations beneath weather-resistant coverings.
  - 2. Interior non-moving gaps around windows, glazed aluminum walls, doors, and penetrations.
- D. Exterior/Interior High-Temperature Silicone Sealant:
  - 1. High-temperature exterior or interior locations.

### **3.9 COLOR SCHEDULE**

#### **A. Sealant Colors:**

1. Exterior Pourable Urethane Sealant:
  - a. Color Selection: As selected from Manufacturer's Standard Colors.
2. Exterior Non-Sag Silicone Sealant:
  - a. Color Selection: As selected from Manufacturer's Standard Colors.
3. Exterior Non-Sag Urethane Sealant for Precast Concrete Seating Bowl:
  - a. Color Selection: As selected from Manufacturer's Standard Colors.
4. Interior Non-Sag Silicone Sealant:
  - a. Color Selection: As selected from Manufacturer's Standard Colors.
5. Interior Non-Sag Urethane Sealant:
  - a. Color Selection: As selected from Manufacturer's Standard Colors.
6. Interior Non-Sag Acrylic Latex Sealant:
  - a. Color Selection: As selected from Manufacturer's Standard Colors.

**END OF SECTION**

**SECTION 07 9500**  
**EXPANSION CONTROL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Expansion control assemblies and supplementary items necessary for installation.

**1.2 DEFINITIONS**

- A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.
- C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or in) or a percentage (plus or minus) of nominal value of joint width.
- D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Placement Drawings: Include line diagrams showing plans, elevations, sections, details, splices, blockout requirements, entire route of each joint system, and attachments to other work. Where joint systems change planes, provide isometric or clearly detailed drawings depicting how components interconnect to achieve continuity and termination of joint covers and fillers.
  - 2. Architectural Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
    - a. Manufacturer and model number for each joint system.
    - b. Joint system location cross-referenced to Drawings.
    - c. Nominal joint width.
    - d. Movement capability.
    - e. Classification as thermal or seismic.
    - f. Materials, colors, and finishes.
    - g. Product options.
    - h. Fire-resistance ratings.

- C. Samples for Verification Purposes: For each type of architectural joint system indicated.
  - 1. Full width by 6 in (150 mm) long, for each system required.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by a qualified testing agency indicating that each product complies with requirements.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

#### **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.



- e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original undamaged packages or acceptable bulk containers.
- B. Store packaged materials to protect them from elements or physical damage.

### **1.8 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

### **1.9 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate installation of exterior expansion control assemblies to ensure that transitions are watertight.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. General: Provide factory-fabricated expansion joint assemblies capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
  - 1. Exterior Joints: Maintain continuity of weather enclosure.

2. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
  3. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
  4. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
  5. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.
  6. Roof Expansion Assemblies: System that remains watertight within movement limitations specified by manufacturer.
- B. Accessibility Requirements for Floor Expansion Joint Systems: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.
- C. Fire-Test-Response Characteristics: Where indicated, provide architectural joint system and fire-barrier assemblies identical to those of assemblies tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

## 2.4 MATERIALS

- A. Aluminum: ASTM B 221 / B 221M, Alloy 6063-T5 for extrusions; ASTM B 209 / B 209M, Alloy 6061-T6 for sheet and plate.
1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard; pre-formed elastomeric membranes or extrusions to be installed in metal frames.
- C. Compression Seals: Manufacturer's standard; pre-formed rectangular elastomeric extrusions having internal baffle system and designed to function under compression.
- D. Strip Seals: Manufacturer's standard; pre-formed elastomeric membrane or tubular extrusions having an internal baffle system and secured in or over a joint by a metal locking rail.
- E. Cellular Foam Seals: Manufacturer's standard; extruded, compressible foam designed to function under compression.
- F. Fire Barriers: Manufacturer's standard; material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period. Fire barriers shall comply with requirements specified in "Performance Requirements" Article for fire-test-response characteristics and be designed for dynamic structural movement without material degradation or fatigue when tested according to ASTM E 1399. Provide fire-rated expansion assemblies with manufacturer's continuous, standard, flexible fire-barrier seals in back of joint system at locations indicated to provide fire-resistance rating not less than rating of adjacent construction.
- G. Moisture Barrier: Manufacturer's standard; material suitable to maintain continuity of weather enclosure.
- H. Accessories: Manufacturer's standard: anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

## 2.5 ARCHITECTURAL JOINT SYSTEMS, GENERAL

- A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
  2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
  3. Fire Barrier: Not less than rating of adjacent construction.
  4. Moisture Barrier: Manufacturer's standard.
- B. Design architectural joint systems for the following size and movement characteristics:
1. Nominal Joint Width: As indicated on Drawings.
  2. Maximum Joint Width: As indicated on Drawings.
  3. Minimum Joint Width: As indicated on Drawings.
  4. Movement Capability: As indicated on Drawings.
  5. Type of Movement: Thermal and Seismic.

## 2.6 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS

- A. Floor-to-Floor Joint Systems: Manufacturers and Products:
1. Type 01:
    - a. Architectural Art Mfg., Inc.; D Series.
    - b. Balco, Inc.; NBA Series.
    - c. Construction Specialties, Inc. (C/S Group); SJ Series.
    - d. InPro Corporation JointMaster; 721 Series.
    - e. MM Systems Corporation; LASB-NB Series. (Basis of Design)
    - f. Watson Bowman Acme Corp.; FJX Series.
  2. Type 02:
    - a. Architectural Art Mfg., Inc.; A Series.
    - b. Balco, Inc.; 6FS Series.
    - c. Construction Specialties, Inc. (C/S Group); ALS Series.
    - d. InPro Corporation JointMaster; 300 Series.
    - e. MM Systems Corporation; HFX Series. (Basis of Design)
    - f. Watson Bowman Acme Corp.; CCS Series.
  3. Type 03:
    - a. Architectural Art Mfg., Inc.; B Series.
    - b. Balco, Inc.; 95FT Series.
    - c. Construction Specialties, Inc. (C/S Group); SGR Series.
    - d. InPro Corporation JointMaster; 222 Series.
    - e. MM Systems Corporation; FDT Series. (Basis of Design)
    - f. Watson Bowman Acme Corp.; TSF Series.
  4. Type 04:
    - a. InPro Corporation JointMaster; 120 Series.

- b. MM Systems Corporation; FSNE Series. (Basis of Design)
  - c. Watson Bowman Acme Corp.; LPF Series.
- 5. Type 05:
  - a. Balco, Inc.; 75FP Series.
  - b. Construction Specialties, Inc. (C/S Group); GFT Series.
  - c. InPro Corporation JointMaster; 101 Series.
  - d. MM Systems Corporation; FS Series. (Basis of Design)
  - e. Watson Bowman Acme Corp.; LPF Series.
- 6. Type 08:
  - a. MM Systems Corporation; HFP Series. (Basis of Design)
  - b. Watson Bowman Acme Corp.; HDH Series.
- 7. Type 09:
  - a. Balco, Inc.; CR Series.
  - b. InPro Corporation JointMaster; 316 Series.
  - c. MM Systems Corporation; HSL Series. (Basis of Design)
  - d. Watson Bowman Acme Corp.; AFJ Series.
- 8. Type 10:
  - a. Balco, Inc.; PS Series
  - b. Construction Specialties, Inc. (C/S Group); SSR Series.
  - c. InPro Corporation JointMaster; 501 Series.
  - d. MM Systems Corporation; PDS Series. (Basis of Design)
  - e. Watson Bowman Acme Corp.; SPJ Series.
- B. Floor-to-Wall Joint (Corner) Systems: Manufacturers and Products:
  - 1. Type 06:
    - a. Balco, Inc.; 95GFVT Series.
    - b. Construction Specialties, Inc. (C/S Group); GFRW Series.
    - c. MM Systems Corporation; FDET Series. (Basis of Design)
    - d. Watson Bowman Acme Corp.; TSF Series.
  - 2. Type 07:
    - a. InPro Corporation JointMaster; 120 Series.
    - b. MM Systems Corporation; FSNE Series. (Basis of Design)
    - c. Watson Bowman Acme Corp.; LPF Series.
  - 3. Type 12:
    - a. MM Systems Corporation; HSC-C Series. (Basis of Design)
    - b. Watson Bowman Acme Corp.; HDH Series.
  - 4. Type 13:
    - a. Construction Specialties, Inc. (C/S Group); SSRW Series.
    - b. InPro Corporation JointMaster; 501 Series.

- c. MM Systems Corporation; PDSE Series. (Basis of Design)
  - d. Watson Bowman Acme Corp.; SPJ Series.
- 5. Type 14:
  - a. Balco, Inc.; NBAL-EW Series.
  - b. MM Systems Corporation; LASBE-NBR Series. (Basis of Design)
- 6. Type 15:
  - a. Balco, Inc.; 2H6FVS Series.
  - b. InPro Corporation JointMaster; 300 Series.
  - c. MM Systems Corporation; HFXE Series. (Basis of Design)
  - d. Watson Bowman Acme Corp.; CCS Series.
- C. Wall-to-Wall Joint Systems: Manufacturers and Products:
  - 1. Type 22:
    - a. Architectural Art Mfg., Inc.; J Series.
    - b. MM Systems Corporation; KX Series. (Basis of Design)
  - 2. Type 23:
    - a. InPro Corporation JointMaster; 101 Series.
    - b. MM Systems Corporation; FSWP Series. (Basis of Design)
  - 3. Type 24:
    - a. Architectural Art Mfg., Inc.; G Series.
    - b. Balco, Inc.; WD Series.
    - c. Construction Specialties, Inc. (C/S Group) ASM Series.
    - d. InPro Corporation JointMaster; 811 Series
    - e. MM Systems Corporation; X-M4M Series. (Basis of Design)
  - 4. Type 25:
    - a. Architectural Art Mfg., Inc.; H Series.
    - b. Balco, Inc.; 6GW Series.
    - c. Construction Specialties, Inc. (C/S Group); AFW Series.
    - d. MM Systems Corporation; FX-K Series. (Basis of Design)
- D. Wall-to-Wall (Corner) Joint Systems: Manufacturers and Products:
  - 1. Type 21:
    - a. Architectural Art Mfg., Inc.; J Series.
    - b. InPro Corporation JointMaster; 101 Series.
    - c. MM Systems Corporation; FSWPL Series. (Basis of Design)
  - 2. Type 28:
    - a. Architectural Art Mfg., Inc.; G Series.
    - b. Balco, Inc.; WD Series.
    - c. Construction Specialties, Inc. (C/S Group); SMS Series.

- d. InPro Corporation JointMaster; 811 Series.
  - e. MM Systems Corporation; X-N4M Series. (Basis of Design)
3. Type 29:
- a. Architectural Art Mfg., Inc.; H Series.
  - b. Balco, Inc.; 6GWC Series.
  - c. Construction Specialties, Inc. (C/S Group); AFW Series.
  - d. MM Systems Corporation; FX-L Series. (Basis of Design)
4. Type 30:
- a. Architectural Art Mfg., Inc.; R Series.
  - b. InPro Corporation JointMaster; 114 Series.
  - c. MM Systems Corporation; VSWL Series. (Basis of Design)
  - d. Watson Bowman Acme Corp.; FSW Series.
- E. Ceiling-to-Wall (Corner) Joint Systems: Manufacturers and Products:
1. Type 26:
- a. Architectural Art Mfg., Inc.; R Series.
  - b. InPro Corporation JointMaster; 115 Series.
  - c. MM Systems Corporation; VSGL Series. (Basis of Design)
  - d. Watson Bowman Acme Corp.; FSC Series.
2. Type 27:
- a. Architectural Art Mfg., Inc.; J Series.
  - b. InPro Corporation JointMaster; 101 Series.
  - c. MM Systems Corporation; FSWPL Series. (Basis of Design)
3. Type 32:
- a. Architectural Art Mfg., Inc.; G Series.
  - b. Balco, Inc.; WD Series.
  - c. Construction Specialties, Inc. (C/S Group); SMC Series.
  - d. InPro Corporation JointMaster; 811 Series.
  - e. MM Systems Corporation; X-N4M Series. (Basis of Design)
4. Type 33:
- a. Architectural Art Mfg., Inc.; H Series.
  - b. Balco, Inc.; 6GWC Series.
  - c. Construction Specialties, Inc. (C/S Group); AFW Series.
  - d. MM Systems Corporation; FX-L Series. (Basis of Design)
5. Type 34:
- a. Construction Specialties, Inc. (C/S Group); HCW Series.
  - b. InPro Corporation JointMaster; 821 Series.
  - c. MM Systems Corporation; DX Series. (Basis of Design)
6. Type 35:

- a. Architectural Art Mfg., Inc.; J Series.
- b. Balco, Inc.; ACL Series.
- c. Construction Specialties, Inc. (C/S Group); FCSC Series.
- d. MM Systems Corporation; CX Series for 1 in (25 mm) and 2 in (50 mm) joints; VSG Series for joints 2 in (50 mm) through 5 in (125 mm). (Basis of Design)

F. Ceiling-to-Ceiling Joint Systems: Manufacturers and Products:

1. Type 31:

- a. Architectural Art Mfg., Inc.; J Series.
- b. InPro Corporation JointMaster; 101 Series.
- c. MM Systems Corporation; FSWP Series. (Basis of Design)

2. Type 36:

- a. Architectural Art Mfg., Inc.; G Series.
- b. Balco, Inc.; WD Series.
- c. Construction Specialties, Inc. (C/S Group); SM Series.
- d. InPro Corporation JointMaster; 811 Series.
- e. MM Systems Corporation; X-M4M Series. (Basis of Design)

3. Type 37:

- a. Architectural Art Mfg., Inc.; H Series.
- b. Balco, Inc.; 6GW Series.
- c. Construction Specialties, Inc. (C/S Group); AFW Series.
- d. MM Systems Corporation; FX-K Series. (Basis of Design)

4. Type 38:

- a. Construction Specialties, Inc. (C/S Group); HC Series.
- b. InPro Corporation JointMaster; 821 Series.
- c. MM Systems Corporation; DX Series. (Basis of Design)
- d. Watson Bowman Acme Corp.; CES Series.

5. Type 39:

- a. Architectural Art Mfg., Inc.; J Series.
- b. Balco, Inc.; AC Series.
- c. Construction Specialties, Inc. (C/S Group); FCS Series.
- d. MM Systems Corporation; CX Series. (Basis if Design)
- e. Watson Bowman Acme Corp.; CEB Series.

6. Type 40:

- a. Architectural Art Mfg., Inc.; J Series.
- b. MM Systems Corporation; KX Series. (Basis of Design)

## 2.7 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING EXTERIORS

- A. Aluminum-Framed, Flexible Seal for Exterior Walls and Soffits: Snap-lock aluminum mounting frame mechanically fastened into substrate; aluminum framing holds continuous extruded flexible primary and backup seals.

1. Manufacturers and Products:

- a. Balco, Inc.; FCVS or FCWW Series.
- b. Construction Specialties, Inc. (C/S Group); SC Series.
- c. InPro Corporation JointMaster; 615 or 616 Series.
- d. MM Systems Corporation; VSS Series.
- e. Watson Bowman Acme Corp.; WSW Series.

B. Elastomeric Extrusion, Preformed Compression Seal: Preformed, elastomeric extrusions having internal baffle system for horizontal and vertical applications, below and above grade, exterior and interior joints, in sizes and profiles as recommended by the manufacturer.

- 1. Provide lubricant and adhesive for installation as recommended by the manufacturer.
- 2. Joint Size: As indicated.
- 3. Color: As selected by Architect from manufacturer's standard colors.
- 4. Manufacturers and Products:

- a. Architectural Art Mfg., Inc.; W Series.
- b. Balco, Inc.; NW Series.
- c. Construction Specialties, Inc. (C/S Group); HB Series.
- d. D.S. Brown Company; Delastic AF Series.
- e. InPro Corporation JointMaster; AR Series.
- f. MM Systems Corporation; ECS Series.
- g. Michael Rizza Company Inc.; CE System.
- h. Watson Bowman Acme Corp.; WE Series.

C. Silicone-Coated, Preformed Compression Seal Expansion Joints: Silicone pre-coated, preformed, precompressed, self-expanding open-cell foam sealant manufactured from polyurethane foam and impregnated with a water-based, stabilized, polymer-modified acrylic; foam contains no waxes or asphalt. It is factory pre-coated with a high-grade water-resistant silicone. Silicone is factory-applied to foam while foam is partially precompressed. When silicone is cured, foam is compressed and a bellows is formed in the coating. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Manufacturers:

- a. Construction Specialties, Inc. (C/S Group)
- b. EMSEAL Joint Systems LTD.
- c. InPro Corporation JointMaster.

- 2. Basis of Design (Product Standard): EMSEAL Joint Systems Ltd; COLORSEAL, color as selected by Architect from manufacturer's standard colors.

## 2.8 ALUMINUM ROOF EXPANSION ASSEMBLY

A. Aluminum Roof Expansion Assemblies: Provide assemblies consisting of aluminum base members and provisions for anchoring and sealing to roofing membrane or flashing in a waterproof-sealed joint. Provide free-to-move, extruded-aluminum cover plate anchored against displacement and waterproofed by integral seals. Provide prefabricated units for corner and joint intersections and horizontal and vertical transitions, including those to other building expansion joints, splicing units, adhesives, coatings, and other components as recommended by roof expansion assembly manufacturer for complete installation.

1. Manufacturers and Products:



- a. Architectural Art Mfg., Inc.; L Series Roof Expansion Covers.
  - b. Balco, Inc.; Types FR / FRE.
  - c. Construction Specialties, Inc. (C/S Group); Models RJ-27 / RJ-28.
  - d. MM Systems Corporation; Styles RXH / RXJ.
  - e. Watson Bowman Acme Corp.; Models RFC / RFC-C or RFL / RFL-C depending upon roof type.
- 2. Base Frame Members: Extruded aluminum.
  - 3. Extruded-Aluminum Covers:
    - a. Covers less than 15 in (375 mm) Wide: Minimum 0.080 in (2 mm) thick.
    - b. Covers 15 in (375 mm) and Wider: Minimum 0.125 in (3 mm) thick.
  - 4. Moisture Barrier: Semi-concealed, captive gaskets at both curb members, of neoprene, EPDM, or PVC, with spring-loaded mechanism to maintain positive pressure between gaskets and curb cap.
  - 5. Fire Barrier: Provide manufacturer's standard fire barrier.
- B. Shop-Fabricated Roof Expansion Joint Covers: Refer to Division 07 Section "Flashing and Sheet Metal."

## 2.9 THERMOPLASTIC ROOF EXPANSION ASSEMBLY

- A. Thermoplastic Roof Expansion Assemblies: Provide assemblies consisting of a dual-seal, double-flanged, extruded thermoplastic rubber member with provisions for anchoring and sealing to roofing membrane. The lower flange is to be welded or adhered to the roof membrane and the upper flange counterflashes the termination bar to seal all penetrations and is flashed to the roofing membrane. Provide prefabricated units for corner and joint intersections and horizontal and vertical transitions, including those to other building expansion joints, splicing units, adhesives, coatings, and other components as recommended by roof expansion assembly manufacturer for complete installation.
- 1. Basis of Design (Product Standard): EMSEAL Joint Systems Ltd; RoofJoint RJ Series.
    - a. Flange Members: PVC thermoplastic alloy or TPV (thermoplastic vulcanizate); as required for roofing membrane.
  - 2. Moisture Barrier: Semi-concealed, captive gaskets at both curb members, of neoprene, EPDM, or PVC, with spring-loaded mechanism to maintain positive pressure between gaskets and curb cap or silicone precoated, preformed compression sealant system; as recommended by manufacturer.
  - 3. Fire Barrier: Provide manufacturer's standard fire barrier.

## 2.10 MISCELLANEOUS MATERIALS

- A. Roofing Cement: ASTM D 4586, Type II.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and to remain watertight as recommended by manufacturer.
- C. Mineral-Fiber Blanket Insulation: ASTM C 665.
- D. Flexible Cellular Sponge or Expanded Rubber: ASTM D 1056.

- E. Silicone Extrusions: Classified according to ASTM D 2000, UV stabilized, and do not propagate flame.
- F. Fasteners: Manufacturer's recommended fasteners suitable for application and designed to withstand design loads.
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

## **2.11 ALUMINUM 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: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of accepted 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 accepted Samples and are assembled or installed to minimize contrast.
- D. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- E. Mill Finish for Floor Covers: AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to removed scratches, welding, or grinding produced in fabrication process).
- F. Clear Anodic Finish for Wall and Ceiling Covers: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.
- C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- D. Coordinate installation of roof expansion assembly materials and associated work so complete assemblies comply with assembly performance requirements.

### 3.4 INSTALLATION

- A. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.
  - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper joint installation and performance.
  - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 4. Locate in continuous contact with adjacent surfaces.
  - 5. Standard-Duty Systems: Shim to level where required. Support underside of frames continuously to prevent vertical deflection when in service.
  - 6. Heavy-Duty Systems: Repair or grout blockout as required for continuous frame support and to bring frame to proper level. Shimming is not allowed.
  - 7. Locate anchors at interval recommended by manufacturer, but not less than 3 in (75 mm) from each end and not more than 24 in (600 mm) on center.
- B. Elastomeric Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
  - 1. Provide in continuous lengths for straight sections.
  - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
  - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- C. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both sides before installing compression seals.
- D. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not over-pressurize.
- E. Cellular Foam Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both sides before installing cellular foam seals.

- F. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.
- G. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
  - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- H. Moisture Barrier: Provide moisture barrier at exterior joints and where called for on Drawings. Provide drainage fittings at a maximum of 50 ft (15 m) or where indicated.
- I. Roof Expansion Assemblies: Extend assemblies over curbs, parapets, cornices, gutters, valleys, fasciae, and other elements in the construction profile, with factory-fabricated intersections and transitions to provide continuous, uninterrupted, waterproof roof expansion assemblies.
  - 1. Install factory-fabricated transitions between roof expansion assemblies and building architectural joint systems to provide continuous, uninterrupted, watertight construction.
  - 2. Splice roof expansion assemblies with materials provided by roof expansion assembly manufacturer for this purpose, according to manufacturer's written instructions, to provide continuous, uninterrupted, waterproof roof expansion assemblies.
  - 3. Provide uniform profile of roof expansion assembly throughout length of each installation; do not stretch polymeric sheets.
  - 4. Install mineral-fiber blanket insulation to fill joint space within joint and moisture barrier.
  - 5. Bed anchorage flanges in roofing cement or sealant recommended by manufacturer and securely nail to curbs and cant strips as recommended by manufacturer but not less than **6 in (150 mm)** on center.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.6 PROTECTION**

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that expansion joint assemblies are without damage or deterioration at time of Substantial Completion.

**END OF SECTION**



## SECTION 08 1113

### HOLLOW METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Custom hollow metal doors and frames and supplementary items necessary for installation.

##### 1.2 DEFINITIONS

- A. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.
- B. Exterior: Areas exposed to the elements and areas located in unconditioned spaces.
- C. Interior: Areas located in conditioned spaces.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Samples for Verification Purposes: Submit 12 in by 12 in (300 mm by 300 mm) samples to demonstrate compliance with requirements for quality of materials and construction:
  - 1. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
  - 2. Frames: Show profile, head-to-jamb corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.
- D. Door and Frame Schedule: Schedule prepared by or under supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Oversize Construction Certification: Documentation for assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Qualification Data:

1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

## **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
  1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.

## **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  3. Record discussions, including decisions and agreements, and prepare report.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4 in (100 mm) high wood blocking. Do not store in a manner that traps excess humidity.



1. Provide minimum 1/4 in (6 mm) space between each stacked door to permit air circulation.

## **1.8 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.9 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate installation of anchorages 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.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. 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.
  1. 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.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.
- D. Smoke-Control Door Assemblies: Assemblies complying with UL 1784.
- E. Exterior Door Air Infiltration: Maximum air leakage of 1.0 cfm/sf (5.08 L/s per sq m) when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sf (75 Pa) .
- F. Windborne-Debris-Impact-Resistance Performance: Comply with impact resistance testing requirements for Wind Zone.

## 2.3 COMPONENT MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008 / A 1008M, Designation CS (Commercial Steel), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011 / A 1011M, Designation CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653 / A 653M, Designation CS (Commercial Steel), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating. Thickness indicated is for uncoated steel.
- D. Frame Anchors: ASTM A 591 / A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 / A 1008M or ASTM A 1011 / A 1011M, hot-dip galvanized according to ASTM A 153 / A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Device type and size required, hot-dip galvanized according to ASTM A 153 / A 153M, Class B.
- F. Fasteners into Concrete:
  - 1. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A 10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching frames into concrete substrate.
  - 2. Available Manufacturers:
    - a. Construction Materials, Inc.
    - b. Heckman Building Products, Inc.
  - 3. Post-Tensioned Concrete: For post-tensioned concrete, fasteners shall not exceed 1 in (25 mm) embedment. Obtain Structural Engineer's written approval for all proposed fasteners in post-tensioned concrete prior to installation.
- G. Mineral-Fiber Insulation for Installations in Sound-Rated Partitions: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6 to 12 lb/cu ft (96 to 192 kg/cu m) density; with following characteristics:
  - 1. Flame-Spread Index: 25 maximum.
  - 2. Smoke Development Index: 50 maximum.
  - 3. Combustion Characteristics: Passing ASTM E 136.
- H. Glazing: Comply with Division 08 Section "Glazing".
- I. Primer: Fast-curing, corrosion-inhibiting, lead and chromate free, universal primer complying with ANSI A224.1 acceptance criteria; compatible with substrate and field-applied finish paint system specified in Division 09 Section "Painting".
- J. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing minimum of 94 percent zinc dust by weight.

## **2.4 FABRICATION, GENERAL**

- A. Fabrication Quality Standard: ANSI/NAAMM-HMMA 861.
- B. General Requirements: Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit, and assemble units in manufacturer's plant.
- C. Accessories: Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to templates furnished as specified in Division 08 Section "Door Hardware".
  - 1. Locate hardware according to ANSI/NAAMM-HMMA 861.
  - 2. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  - 3. Comply with applicable requirements in ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

## **2.5 HOLLOW METAL DOORS**

- A. Fabrication Provisions: Fabricate doors not less than 1-3/4 in (44 mm) thick, of seamless hollow construction unless otherwise indicated. Construct doors with smooth surfaces without visible joints or seams on exposed faces.
  - 1. Glazed Lites: Factory cut openings in doors.
- B. Door Face Sheets:
  - 1. Metallic-coated steel sheet, minimum 0.053 in (1.3 mm) (16 gage) thick for doors in the following locations:
    - a. Exterior doors.
  - 2. Cold-rolled steel sheet, minimum 0.042 in (1.10 mm) (18 gage) thick for doors in the following locations:
    - a. Interior doors.
- C. Core Construction:
  - 1. Steel-Stiffened Core: 0.026 in (0.7 mm) (22 gage) thick, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 in (150 mm) apart, spot welded to face sheets a maximum of 5 in (125 mm) on centers. Spaces filled between stiffeners with mineral-fiber insulation.
  - 2. Fire Door Core: As required to provide fire-protection indicated.
  - 3. Thermal-Rated (Insulated) Core: Typical at Exterior doors and otherwise indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F by h by sq ft/Btu (0.704 K by sq m/W) according to ASTM C 1363.

- D. Vertical Edges:
1. Single Acting Doors: Beveled 1/8 in in 2 in (3 mm in 50 mm).
  2. Double Acting Doors: Round vertical edges with 2-1/8 in (53 mm) radius.
- E. Top and Bottom Channels: Closed with continuous channels, minimum 0.053 in (1.3 mm) (16 gage) thick, of same material as face sheets and spot welded to both face sheets.
1. Spot weld metal channel not more than 6 inches (150 mm) on center.
- F. Exterior doors shall be closed flush at the top edge. Seal joints in top edges of door against water penetration. Where required for attachment for weatherstripping, a flush closure channel shall also be provided at the bottom edge.
1. Openings shall be provided in the bottom closure channel of exterior doors to permit the escape of trapped moisture.
- G. Hardware Reinforcement: Fabricate from same material as door. Minimum thickness of steel reinforcing plates for following hardware:
1. Hinges and Pivots: 0.167 in (4.2 mm) (7 gage) thick by 1-1/2 in wide by 6 in (38 mm by 150 mm) longer than hinge, secured by not less than 6 spot welds.
  2. Strikes, Flush Bolts, and Closers: 0.093 in (2.3 mm) (12 gage).
  3. Surface-Mounted Hold-Open Arms and Panic Devices: 0.093 in (2.3 mm) (12 gage).
- H. Glass Molding and Stops: Provide frame for glazed openings between face sheets continuously around perimeter of glass opening and weld to face sheets.
1. Form frame with integrally formed stop on security side.
  2. Miter corners, weld, and grind smooth.
  3. Do not overlap frame molding on face of door.
  4. Use same materials as door face sheet for frame and loose stop for flush glazing.
- I. Louvers: Stationary louvers constructed with inverted V-shaped or Y-shaped blades with blades or baffles and frame formed of same materials as door face sheet. Fabricate louvers and mount flush into doors without overlapping moldings on surface of door face sheets. Provide internal support recommended by manufacturer. Provide louvers with minimum of 50% free air area.
1. Automatic Louvers at Fire-Rated Doors: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.
- J. Transom Panels: Provide panels of same materials, construction, and finish as specified for doors.

## **2.6 HOLLOW METAL FRAMES**

- A. Fabrication Provisions:
1. Fabricate frames of construction indicated below.
  2. Close contact edges of corner joints tight with faces mitered and full-profile continuously welded.

- a. "Knock-down" frame construction is not acceptable and shall not be used.
  3. Close contact edges of stops butted or mitered.
  4. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
- B. Joinery:
1. Fabrication Quality Standard: Head-to-jamb joints according to ANSI/NAAMM-HMMA 820 for either of following fabrication techniques with:
    - a. Saw-mitered corners, full-profile continuously welded.
    - b. Machine-mitered corners, full-profile continuously welded.
  2. Externally or internally weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and seamless.
  3. Internally weld rabbet and soffits continuously; grind, fill, dress, and make smooth.
  4. Use of gusset or splice plates as substitute for fully welding is not permitted.
- C. Materials and Thickness:
1. Metallic-coated steel sheet, 0.067 in (1.7 mm) (14 gage) thick for frames in the following locations:
    - a. Exterior frames.
  2. Cold-rolled steel sheet for frames in the following locations:
    - a. Interior frames.
  3. Thickness for Cold-Rolled Steel Sheet Frames:
    - a. 48 in (1200 mm) Wide or Less: 0.053 in (1.3 mm) (16 gage) thick.
    - b. More than 48 in (1200 mm) Wide: 0.067 inch (1.7 mm) (14 gage) thick.
  4. Sidelight and Transom Frames: Closed tubular members with no visible face seams or joints fabricated from same type and thickness of material as adjacent door frame.
  5. Interior Borrowed-Light Frames: Fabricated from 0.053 in (1.3 mm) (16 gage) thick cold-rolled steel sheet.
- D. Stops and Moldings:
1. Form corners with butted or mitered hairline joints.
  2. Provide around glazed lites where indicated.
    - a. Fixed frame moldings on outside of exterior doors and frames and on secure side of interior doors and frames.
    - b. Loose stops and moldings on inside of hollow metal work so that glass can be removed independently.
  3. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
- E. Hardware Reinforcement: Fabricate from same material as frame. Minimum thickness of steel reinforcing plates for following hardware:

1. Hinges and Pivots: 0.167 in (4.2 mm) (7 gage) thick by 1-1/2 in wide by 6 in (38 mm by 150 mm) longer than hinge, secured by not less than 6 spot welds.
  2. Strikes, Flush Bolts, and Closers: 0.093 in (2.3 mm) (12 gage).
  3. Surface-Mounted Hold-Open Arms and Panic Devices: 0.093 in (2.3 mm) (12 gage).
- F. Head Reinforcement: Provide minimum 0.093 in (2.3 mm) (12 gage) thick, steel channel or angle stiffener for opening widths more than 48 in (1200 mm).
- G. Jamb Anchors:
1. Types: Fabricated of same material as frame:
    - a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 in (1.10 mm) (18 gage) thick.
    - b. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 in (1.10 mm) (18 gage) thick, with corrugated or perforated straps not less than 2 in (50 mm) wide by 10 in (250 mm) long.
    - c. Postinstalled Expansion Type for In-Place Concrete or Masonry: Countersunk, flat or oval head exposed screws and bolts with expansion shields or inserts, minimum 3/8 in (10 mm) diameter bolts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
  2. Quantity and Location:
    - a. Stud-Wall Type: Locate anchors not more than 18 in (450 mm) from top and bottom of frame. Space anchors not more than 32 in (800 mm) on centers and as follows:
      - 1) Three anchors per jamb up to 60 in (1500 mm) high.
      - 2) Four anchors per jamb from 60 to 90 in (1500 to 2250 mm) high.
      - 3) Five anchors per jamb from 90 to 96 in (2250 to 2400 mm) high.
      - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 in (600 mm) or fraction thereof above 96 in (2400 mm) high.
      - 5) Two anchors per head for frames above 42 in (1050 mm) wide and mounted in metal-stud partitions.
    - b. Masonry Type: Locate anchors not more than 18 in (450 mm) from top and bottom of frame. Space anchors not more than 32 in (800 mm) on centers and as follows:
      - 1) Two anchors per jamb up to 60 in (1500 mm) high.
      - 2) Three anchors per jamb from 60 to 90 in (1500 to 2250 mm) high.
      - 3) Four anchors per jamb from 90 to 120 in (2250 to 3000 mm) high.
      - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 in (600 mm) or fraction thereof above 120 in (3000 mm) high.
    - c. Postinstalled Expansion Type for In-Place Concrete or Masonry: Locate anchors not more than 6 in (150 mm) from top and bottom of frame and not more than 26 in (650 mm) on centers.
- H. Floor Anchors: Formed from same material as frames welded to bottom of jambs and mullions with not less than 4 spot welds, not less than 0.0428 in (1.10 mm) (18 gage) thick, and as follows, terminating bottom of frames at finish floor surface:

1. Monolithic Concrete Slabs: Clip type anchors, with two holes to receive fasteners.
  2. Separate Topping Concrete Slabs: Adjustable type anchors with extension clips, allowing not less than 2 in (50 mm) height adjustment.
- I. Shipping Spreader Bars: Attach two removable metal spreader bars across bottom of frames, tack welded to jambs and mullions.
  - J. Door Silencers: Except on weatherstripped doors, drill holes to receive door silencers furnished under Division 08 Section "Door Hardware". Keep holes clear during construction.
    1. Single-Door Frames: Strike jamb for 3 door silencers.
    2. Double-Door Frames: Head jamb for 2 door silencers.

## **2.7 STEEL FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for cleaning, treating, priming, and when specified, finishing.
- B. Finish products specified in this Section after fabrication.
- C. Metallic-Coated Steel Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to primer to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
  1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- D. Non-Coated Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Prime Coat Finish: Apply manufacturer's standard primer specified below immediately after surface preparation and pretreatment.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- F. Field-Applied Coatings: As specified in Division 09 Section "Painting".

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. ANSI/NAAMM-HMMA 840.
  2. NFPA 80 for fire-rated doors and frames.
  3. NFPA 105 for smoke control doors and frames.
  4. DHI A115.IG.
  5. Respective manufacturer's written installation instructions.
  6. Accepted submittals.
  7. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Pre-Installation Tolerances: Prior to installation, adjust and securely brace hollow metal frames for squareness, alignment, twist, and plumbness to following:
1. Squareness: Plus or minus 1/16 in (1.5 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 in (1.5 mm), measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 in (1.5 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 in (1.5 mm), measured at jambs on a perpendicular line from head to floor.
- C. Hardware Preparation: Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

### **3.4 INSTALLATION OF HOLLOW METAL DOORS AND FRAMES**

- A. Hollow Metal Frames: Install hollow metal frames of size and profile indicated.
1. Setting: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and welded-in shipping spreader bars. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
    - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install frames with removable glazing stops located on secure side of opening.
    - c. Install door silencers in frames before grouting.
    - d. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors or powder actuated fasteners.



3. Sound-Rated Partitions: Solidly pack mineral-fiber insulation behind frames.
  4. Exterior Walls: Solidly fill space between frames and wall construction with mineral-fiber insulation unless indicated otherwise.
  5. In-Place Masonry or Concrete Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
  7. Installation Tolerances: Adjust hollow metal frames for squareness, alignment, twist, and plumb to following:
    - a. Squareness: Plus or minus 1/16 in (1.5 mm), measured at rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 in (1.5 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 in (1.5 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 in (1.5 mm), measured at jambs at floor.
- B. Hollow Metal Doors: Provide insulated doors at exterior and non-insulated at interior locations. Fit accurately in frames, within following clearances:
1. Jambs and Head: 1/8 in (3 mm) plus or minus 1/16 in (1.5 mm).
  2. Between Edges of Pairs of Doors: 1/8 in (3 mm) plus or minus 1/16 in (1.5 mm).
  3. Between Bottom of Door and Top of Threshold: Maximum 3/8 in (10 mm).
  4. Between Bottom of Door and Top of Finish Floor Covering or Top of Structure (No Threshold): Maximum 3/4 in (19 mm).
- C. Glazing:
1. Comply with installation requirements in Division 08 Section "Glazing".
  2. Secure stops with countersunk flat or oval head machine screws spaced uniformly not more than 6 in (150 mm) on center and not more than 2 in (50 mm) on centers from each corner.

### **3.5 ADJUSTMENTS**

- A. Final Adjustments: Remove and replace defective hollow metal work, including work that is warped, bowed, or otherwise unacceptable.
- B. Prime Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of primer compatible with paint specified in Division 09 Section "Painting".
- C. Metallic-Coated Surfaces: Prepare and repair damaged galvanized coatings on fabricated and installed hollow metal work with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- D. Field-Applied Coatings: As specified in Division 09 Section "Painting".

**END OF SECTION**

## SECTION 08 1416

### PREFINISHED FLUSH WOOD DOORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Prefinished flush wood doors and supplementary items necessary for installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  2. Include details of core and edge construction, light frames, and trim for openings.
  3. Include factory-finishing specifications.
  4. Include manufacturer's surface preparation instructions.
  5. Indicate scheduled fire doors that cannot qualify for labeling because of design, size, hardware or other reason.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Provide dimensioned drawings indicating location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
1. Indicate dimensions and locations of mortises and holes for hardware.
  2. Indicate dimensions and locations of cutouts.
  3. Indicate requirements for door face matching.
  4. Indicate doors to be factory finished and finish requirements.
  5. Indicate fire-protection-ratings for fire-rated doors.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Wood Veneer Door Faces: Full range of colors available.
  2. Opaque Finish Doors: Full range of colors available.
  3. Plastic Laminate Door Faces: Full range of colors, textures, and patterns available.
  4. Impact Resistant Panel Door Faces: Full range of colors, textures, and patterns available.
- D. Samples for Verification Purposes: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Wood Veneer Doors: Wood veneer factory finishes applied to actual door face materials, approximately 8 in by 10 in (200 mm by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of 3 samples showing typical range of color and grain to be expected in finished work.
  2. Opaque Finish Doors: Opaque door facing, 6 in (150 mm) square, for each color selected.

3. Plastic Laminate Doors: Plastic laminate door facing, 6 in (150 mm) square, for each color, texture, and pattern selected.
4. Impact Resistant Panel Doors: Impact resistant panel door facing, 6 in (150 mm) square, for each color, texture, and pattern selected.
5. Corner sections of doors, approximately 8 in by 10 in (200 mm by 250 mm), with door faces and edges representing actual materials to be used.
  - a. Wood Veneer Doors: Samples for each species of wood veneer and solid lumber required.
  - b. Opaque Finish Doors: Samples for each color selected.
  - c. Plastic Laminate Doors: Samples for each color, texture, and pattern of plastic laminate door facing required.
  - d. Impact Resistant Panel Doors: Samples for each color, texture, and pattern of impact resistant panel door facing required.
  - e. Finish door facing samples with same materials proposed for factory-finished doors.
6. Light Frames: Frames for light openings, 6 in (150 mm) long, for each material, type, and finish required.
7. Door Louvers: Louver blade and frame sections, 6 in (150 mm) long, for each material and finish specified.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Qualification Data:
  1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- C. Warranty: Sample of warranty.
  1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: To include in maintenance manuals.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.

### **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.

- c. Installer, including project manager and supervisor.
  - d. If requested, Manufacturer's qualified technical representative.
  - e. Installers of other construction interfaced with Work.
2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
- a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. General: Comply with requirements of referenced quality standards and manufacturer's written instructions.
  - 1. Package doors individually.
  - 2. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration.
  - 3. Mark each door on top and bottom rail with opening number used on Shop Drawings.

## **1.8 PROJECT CONDITIONS**

- A. Environmental Limitations: Deliver and install doors only when spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

## **1.9 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. Warranty shall also include finishing that may be required due to repair or replacement of defective doors. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  - 1. Defects include, but are not limited to, the following:
    - a. Warping (Bow, Cup, or Twist): Not more than 1/4 in (6 mm) in a 42 by 84 in (1050 by 2100 mm) section.

- b. Telegraphing of Core Construction: Not more than 0.01 in in a 3 in (0.25 mm in a 75 mm) span in face veneers.
2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period as follows:
  - a. Warranty Period for Solid-Core Interior Doors: Life of installation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  1. Algoma Hardwoods, Inc.
  2. Construction Specialties, Inc. (C/S Group)
  3. Eggers Industries.
  4. Marshfield Door Systems, Inc.
  5. Mohawk Flush Doors, Inc.; a Masonite Company.
  6. Oshkosh Architectural Door Company.
  7. VT Industries Inc.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  1. Fire Resistance Ratings: Products and construction identical to assemblies tested for fire resistance according to NFPA 252 or UL 10C and included under Category GSZN, Category A, published in Underwriters Laboratories, Inc. (UL) "Fire Resistance Directory"; or listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Positive Pressure Testing: After 5 minutes into test, neutral pressure level in furnace shall be established at 40 in (1000 mm) or less above sill.
  3. 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.
  4. Availability: If specified as fire-rated and labeled door can be obtained from one manufacturer, no consideration will be given to those manufacturers who are not authorized to manufacture such doors.
  5. Smoke-Control Door Assemblies: Comply with UL 1784.

### **2.4 DOOR CONSTRUCTION, GENERAL**

- A. Product Quality Standard: In addition to standard listed elsewhere, comply with following, unless otherwise specified, for construction, finishes, installation, and other requirements.

1. Quality Standard: Comply with "Architectural Woodwork Standards".
  - a. Provide AWI Quality Certification Program labels and certificates indicating that woodwork, including installation, complies with requirements of grades specified.
  - b. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
  - c. Typical Doors: WDMA I.S.1-A Performance Grade: Heavy Duty, minimum.
  
- B. Particleboard Core Doors:
  1. Particleboard: ANSI A208.1, Grade LD-2.
  2. Blocking: Provide wood blocking as needed to eliminate through-bolting hardware and as follows:
    - a. Top Rail: 5 in (125 mm).
    - b. Bottom Rail: 5 in (125 mm).
    - c. Mid Rail: 5 in (125 mm), in doors indicated to have exit devices.
    - d. Lock Blocks: 5 in by 10 in (125 mm by 250 mm), one for lock and two for exit devices.
  
- C. Fire-Protection-Rated Doors: Mineral core as required for fire-protection-rating indicated.
  1. Edge: Construction with intumescent seals; where positive pressure fire testing is required, edge construction with intumescent seals concealed by outer stile matching door face material and laminated backing at hinge stiles for improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
  2. Pairs: Fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Comply with specified requirements for exposed edges.
  
- D. Structural Composite Lumber Core Doors:
  1. Structural Composite Lumber: WDMA I.S.10.
  2. Screw Withdrawal, Face: 700 lbf (3100 N).
  3. Screw Withdrawal, Edge: 400 lbf (1780 N).
  
- E. Mineral Core Doors:
  1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection-rating indicated.
  2. Blocking: Provide fire resistant composite blocking with improved screw-holding capability approved for use in doors of fire-protection-ratings indicated as needed to eliminate through-bolting hardware and as follows:
    - a. Top Rail: 5 in (125 mm).
    - b. Bottom Rail: 5 in (125 mm).
    - c. Mid Rail: 5 in (125 mm), in doors indicated to have exit devices.
    - d. Lock Blocks: 5 in by 10 in (125 mm by 250 mm), one for lock and two for exit devices.

## 2.5 WOOD VENEER FACED DOORS FOR TRANSPARENT FINISH

### A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade AA wood veneer faces.
2. Species Cut Selection: As scheduled or as indicated in Design Selections.
  - a. Matching of Adjacent Veneer Leaves: Book or Slip match.
  - b. Assembly of Veneer Leaves on Door Faces: Balance or Center-Balance match.
  - c. Room Match: Match door faces within each separate room or area of building. Corridor door faces do not need to match where they are separated by not less than 20 ft (6 m) or more.
  - d. Pair and Set Match: For doors hung in same opening or separated only by mullions.
  - e. Transom Match: Continuous match.
  - f. Blueprint Match: Where indicated, provide doors with faces produced from same wood veneer flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Division 06 Section "Interior Architectural Woodwork".
3. Exposed Vertical Edges: Same wood veneer as face veneer with sanded eased edges.
4. Horizontal Edges: Unfaced, sanded smooth, with factory applied seal coat.
5. Core: Particleboard or mineral core as required by application.
6. Construction: 5 plies.
  - a. Stiles and rails bonded to core.
  - b. Entire unit abrasive planed before veneering.
  - c. Faces bonded to core using a hot press.

## 2.6 DOORS FOR OPAQUE FINISH

### A. Interior Solid-Core Doors:

1. Grade: Premium.
2. Faces: Apply medium-density overlay to standard-thickness, closed-grain, hardwood face veneers.
3. Color Selection: As scheduled or as indicated in Design Selections.
4. Exposed Vertical and Horizontal Edges: Any closed-grain hardwood with sanded eased edges.
5. Core: Particleboard.
6. Construction: 5 plies.
  - a. Stiles and rails bonded to core.
  - b. Entire unit abrasive planed before veneering.
  - c. Faces bonded to core using a hot press.

## 2.7 LIGHT FRAMES

### A. Wood Beads for Light Openings in Wood Doors:

1. Description: Manufacturer's standard wood beads and profile. At wood-core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.
2. Material and Finish: Same veneer species and finish as door faces.
3. Glass: As specified in Division 08 Section "Glazing".



- B. Wood Veneered Beads for Light Openings in Fire-Rated Doors:
  - 1. Description: Manufacturer's standard wood veneered, noncombustible beads approved for use in doors of fire protection rating indicated. Include concealed metal glazing clips where required for opening size and fire protection rating indicated.
  - 2. Material and Finish: Same veneer species and finish as door faces.
  - 3. Glass: As specified in Division 08 Section "Glazing".
- C. Metal Frames for Light Openings in Fire-Rated Doors:
  - 1. Description: Manufacturer's standard frame formed of 0.048 in (1.2 mm) thick, cold-rolled steel sheet; and approved for use in doors of fire protection rating indicated.
    - a. Color Selection: As scheduled or as indicated in Design Selections.
  - 2. Glass: As specified in Division 08 Section "Glazing".

## 2.8 DOOR LOUVERS

- A. Wood Louvers:
  - 1. Description: Manufacturer's standard solid-wood louvers.
  - 2. Material and Finish: Same veneer species and finish as door faces.
- B. Metal Louvers:
  - 1. Description: Vision-proof, inverted V louver blades set in continuous metal frame that covers edge of door cutout.
  - 2. Metal: Extruded aluminum.
    - a. Finish: Class II, clear anodic finish, AA-M12C22A31.
  - 3. Metal: Hot-dip galvanized steel, 0.040 in (1.0 mm) thick,
    - 1) Color Selection: As scheduled or as indicated in Design Selections.
- C. Metal Louvers for Fire-Rated Doors:
  - 1. Description: Louver with fusible link and closing device listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less; set in continuous metal frame that covers edge of door cutout.
  - 2. Metal: Hot-dip galvanized steel, 0.040 in (1.0 mm) thick,
    - 1) Color Selection: As scheduled or as indicated in Design Selections.
- D. Manufacturers:
  - 1. Air Louvers Inc.
  - 2. Anemostat; a Mestek Company.
  - 3. Hiawatha Incorporated.
  - 4. L & L Louvers, Inc.
  - 5. LL Building Products, Inc.; a Division of GAF Materials Corporation.
  - 6. Louvers & Dampers, Inc.; a Mestek Company.
  - 7. McGill Architectural Products.

## 2.9 FABRICATION OF PREFINISHED FLUSH WOOD DOORS

- A. Fabrication Quality Standards: In addition to standards listed elsewhere, comply with following, unless otherwise specified:
1. NFPA 80 for fire-rated doors.
  2. DHI-WDHS-3 and DHI A115-W series standards for hardware.
- B. Factory Fitting: Factory fit doors to suit frame opening sizes indicated according to installation quality standards. Do not trim stiles and rails in excess of limits permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining with seal coat.
- C. Hardware:
1. Factory machine doors for hardware that is not surface applied according to installation quality standards.
  2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  3. For doors scheduled to have electrical locks, provide built-in 1/4 in (6 mm) diameter raceway through doors, from lockset location to nearest hinge location, for low voltage wiring for doors scheduled to have electric locks.
- D. Transom Panels: Fabricate matching panels of same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
- E. Openings: Cut and trim openings through doors in factory.
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 Division 08 Section "Glazing".
  3. Louvers: Factory-install louvers in prepared openings.

## 2.10 FACTORY FINISHING OF DOORS

- A. General:
1. Comply with referenced quality standard for factory finishing.
  2. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  3. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on edges of cutouts and mortises.
- B. Grade: Provide finishes of same grades as items to be finished.
- C. Wood Veneer Faced Doors for Transparent Finish: As scheduled or as indicated in Design Selections.
- D. Doors for Opaque Finish: As scheduled or as indicated in Design Selections.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
1. Verify that 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.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
1. NFPA 80 for fire-rated doors.
  2. NFPA 105 for smoke control doors.
  3. Respective manufacturer's written installation instructions.
  4. Accepted submittals.
  5. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF FLUSH WOOD DOORS**

- A. Factory-Fitted Door Clearances: Fit accurately in frames, within following clearances for all doors (smoke control, fire-rated, and non-fire-rated):
1. Jambs and Head: 1/8 in (3 mm) maximum.
  2. Between Edges of Pairs of Doors: 1/8 in (3 mm) maximum.
  3. Between Bottom of Door and Top of Threshold: Maximum 3/8 in (10 mm).
  4. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 in (19 mm).
  5. Between Bottom of Door and Top of Finish Surface (No Threshold) when the bottom of the door is more than 38 in (965 mm) above the finished floor: Maximum 3/8 in (10 mm) or as specified by the manufacturer's label service procedure.
- B. Hardware: As specified in Division 08 Section "Door Hardware".
- C. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### **3.5 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.

### **3.6 FINISH SCHEDULE**

- A. Wood Veneer Faced Doors for Transparent Finish:
  - 1. Species and Cut Selection: Match sample accepted by Architect. Existing

**END OF SECTION**

## SECTION 08 3113

### ACCESS DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Access doors and frames and supplementary items necessary for installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Ceiling Coordination Drawings for Access Doors at Ceilings: Furnish reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other. Indicate method of attaching door frames to surrounding construction.
- D. Samples for Verification Purposes: For each door face material, at least 3 in by 5 in (75 mm by 125 mm) in size, in specified finish.
- E. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

##### 1.5 QUALITY ASSURANCE

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. NFPA 252 or UL 10B for vertical access doors and frames.
  - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.

- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

## **1.6 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

- 1. Metal Doors and Frames:

- a. Acudor Products, Inc.
- b. Babcock-Davis.
- c. Dur-Red Products.
- d. J. L. Industries, Inc.
- e. Karp Associates, Inc.
- f. Larsen's Manufacturing Company.
- g. Maxam Metal Products, Ltd.
- h. Milcor Inc.
- i. Nystrom, Inc.
- j. Williams Brothers Corporation of America.

- 2. Glass-Fiber-Reinforced Gypsum (GFRG) Doors and Frames:

- a. Chicago Metallic Corporation.

- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 STEEL MATERIALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36 / A 36M.

- 1. ASTM A 123 / A 123M, for galvanizing steel and iron products.
- 2. ASTM A 153 / A 153M, for galvanizing steel and iron hardware.

- B. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A 1008 / A 1008M, Commercial Steel (CS), exposed.
- C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning", to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning", or SSPC-SP 8, "Pickling".
  - 2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.
- D. Drywall Beads: Edge trim formed from 0.0299 in (0.7 mm) zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.
- E. Plaster Beads: Casing bead formed from 0.0299 in (0.7 mm) zinc-coated steel sheet with flange formed out of expanded metal lath and in size to suit thickness of plaster.

## **2.4 STAINLESS-STEEL MATERIALS**

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 316. Remove tool and die marks and stretch lines or blend into finish.
  - 1. Finish: Directional No. 4 Satin Finish.

## **2.5 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS**

- A. Non-rated Flush Access Doors and Frames with Exposed Trim:
  - 1. Locations:
    - a. Masonry wall surfaces.
    - b. Ceramic tile wall surfaces.
  - 2. Fabricated from one of the following as scheduled at the end of this Section.
    - a. Steel sheet.
    - b. Metallic-coated (galvanized) steel sheet.
  - 3. Door: Minimum 0.075 in (1.9 mm) thick sheet metal, set flush with exposed face flange of frame.
  - 4. Frame: Minimum 0.060 in (1.5 mm) thick sheet metal with 1-1/4 in (32 mm) wide, surface-mounted trim.
  - 5. Hinges: Continuous piano.
  - 6. Lock: Key-operated cylinder.
  - 7. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
  - 8. Basis of Design: Nystrom Building Products, Model NT.
- B. Non-rated Flush Access Doors and Trimless Frames:
  - 1. Locations: Wall and ceiling surfaces as scheduled.
    - a. Gypsum board wall and ceiling surfaces.

- b. Plaster wall and ceiling surfaces.
  - 2. Fabricated from one of the following as scheduled at the end of this Section.
    - a. Steel sheet.
    - b. Stainless-steel sheet.
  - 3. Door: Minimum 0.075 in (1.9 mm) thick sheet metal, set flush with surrounding finish surfaces.
  - 4. Frame: Minimum 0.060 in (1.5 mm) thick sheet metal with drywall bead flange.
  - 5. Hinges: Continuous piano.
  - 6. Lock: Key-operated cylinder.
  - 7. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
  - 8. Basis of Design: Nystrom Building Products, Model NW or NP as applicable.
- C. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim:
  - 1. Locations:
    - a. Masonry wall surfaces.
    - b. Ceramic tile wall surfaces.
  - 2. Fabricated from one of the following as scheduled at the end of this Section.
    - a. Steel sheet.
    - b. Stainless-steel sheet.
  - 3. Fire-Resistance Rating: Not less than 1-1/2 hours.
  - 4. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
  - 5. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 in (0.9 mm).
  - 6. Frame: Minimum 0.060 in (1.5 mm) thick sheet metal with 1 in (25 mm) wide, surface-mounted trim.
  - 7. Hinges: Continuous piano.
  - 8. Automatic Closer: Spring type.
  - 9. Latch: Self-latching device operated by flush key with interior release.
  - 10. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
  - 11. Basis of Design: Nystrom Building Products, Model IT.
- D. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames:
  - 1. Locations:
    - a. Gypsum board wall and ceiling surfaces.
    - b. Plaster wall and ceiling surfaces.
  - 2. Fabricated from one of the following as scheduled at the end of this Section.
    - a. Steel sheet.
    - b. Stainless-steel sheet.
  - 3. Fire-Resistance Rating: Not less than 1-1/2 hours.
  - 4. Temperature Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.



5. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 in (0.9 mm).
6. Frame: Minimum 0.060 in (1.5 mm) thick sheet metal with drywall bead.
7. Hinges: Continuous piano.
8. Automatic Closer: Spring type.
9. Latch: Self-latching device operated by flush key with interior release.
10. Size: 12 in by 12 in (300 mm by 300 mm); unless otherwise indicated.
11. Basis of Design:
  - a. Gypsum Board: Nystrom Building Products, Model IW.
  - b. Plaster: Nystrom Building Products, Model IP.

## **2.6 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 attachment devices and fasteners of type required to secure access panels to types of supports indicated.
  1. Gypsum Board Locations: For trimless frames with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
  2. Provide mounting holes in frames for attachment of units to metal framing.
  3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
  1. For cylinder lock, furnish two keys per lock and key all locks alike.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Advise installers of other work about specific requirements relating to access door and floor door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

### **3.4 INSTALLATION OF ACCESS DOORS AND FRAMES**

- A. Frames with Masonry Anchors: Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

### **3.5 ADJUSTING AND CLEANING**

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

### **3.6 ACCESS DOOR SCHEDULE**

- A. Provide access doors where indicated on the drawings and as follows:
  - 1. Steel Access Doors:
    - a. Concealed valves and controls for plumbing and HVAC.
    - b. Fire dampers above non-accessible ceilings.
    - c. Motor operated doors and grilles above non-accessible ceilings.
  - 2. Fire-Rated Steel Access Doors:
    - a. Rated walls and ceilings.
  - 3. Stainless Steel Access Doors:
    - a. Ceramic tile and other damp locations.

**END OF SECTION**

## SECTION 08 3313

### COILING COUNTER DOORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Coiling counter doors and supplementary items necessary for installation of the following:
  - 1. Counter doors.
  - 2. Fire-rated counter doors.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, dimensions of individual components, profiles for curtain components, installation instructions, and recommendations for maintenance.
  - 2. Power Operated Units: Include rated capacities, operating characteristics, and electrical characteristics. Include nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
  - 3. Fire-Rated or Smoke-Rated Units: For fire-rated or smoke-rated coiling counter doors, include description of fire-release system including testing and resetting instructions.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams for Power Operated Units: For power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
  - 3. Fusible Links for Fire-Rated or Smoke-Rated Units: Show locations of replaceable fusible links.
- C. Samples for Verification Purposes: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Door Curtain Slats: 12 in (300 mm) square.
  - 2. Bottom Bar: 6 in (150 mm) long.
  - 3. Guides: 6 in (150 mm) long.
  - 4. Brackets: 6 in (150 mm) square.
  - 5. Hood: 6 in (150 mm) square.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- C. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: To include in maintenance manuals.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- C. 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 as close to neutral pressure as possible according to NFPA 252 or UL 10B.
  - 1. 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 Typically retain subparagraph below unless there is certainty that this is not needed in the project.
  - 2. Smoke- and Draft-Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sf (0.01524 cu. m/s x sm) of door opening at 0.10 in wg (24.9 Pa) for both ambient and elevated temperature tests.
- D. Electrical Components, Devices, and Accessories for Power Operated Units: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  3. Record discussions, including decisions and agreements, and prepare report.

## **1.7 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
1. The Cookson Company.
  2. Cornell Iron Works, Inc.
  3. McKeon Rolling Steel Door Company, Inc.
  4. Overhead Door Corporation.
  5. Raynor Garage Doors.
  6. Wayne-Dalton Corporation.
  7. Windsor Republic Doors.

## 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## 2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles. 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.**

## 2.4 COILING COUNTER DOOR MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats 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. Interior Fire-Rated Units:
    - a. Stainless Steel Door Curtain Slats: ASTM A 666, Type 304; minimum sheet thickness of 0.025 in (0.64 mm) as required to meet performance requirements.
    - b. Galvanized Steel Door Curtain Slats: Hot-dip zinc-coated (galvanized) complying with ASTM A 123 (ASTM A 123M), or electrogalvanized complying with ASTM 653 (ASTM A 653M), and phosphatized before fabrication; nominal sheet thickness (coated) of 0.028 in (0.7 mm) as required to meet performance requirements.
    - c. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
  - 2. Interior Smoke-Rated Units (for Use in "Smoke-Tight" Walls):
    - a. Galvanized Steel Door Curtain Slats: Hot-dip zinc-coated (galvanized) complying with ASTM A 123 (ASTM A 123M), or electrogalvanized complying with ASTM 653 (ASTM A 653M), and phosphatized before fabrication; nominal sheet thickness (coated) of 0.028 in (0.7 mm) as required to meet performance requirements.
    - b. Stainless Steel Door Curtain Slats: ASTM A 666, Type 304; minimum sheet thickness of 0.025 in (0.64 mm) as required to meet performance requirements.
    - c. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Endlocks:
  - 1. Counter Doors: Manufacturer's standard locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. 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.

- E. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain and a continuous bar for holding windlocks. Where indicated or where required, provide manufacturer's standard.

## **2.5 HOOD**

- 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 project beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Material: Match hood material with that of door curtain slat material and as follows:
    - a. Galvanized Steel: Nominal 0.028 in (0.7 mm) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653 (ASTM A 653M).
    - b. Stainless Steel: 0.025 in (0.64 mm) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
    - c. Aluminum: 0.040 in (1.0 mm) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
  - 2. Locations: Provide at door units where coiled curtain and operating mechanisms are exposed and not concealed in ceiling or soffit.
  - 3. Fire-Rated and Smoke-Rated Doors: Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

## **2.6 LOCKING DEVICES**

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware".
- B. Safety Interlock Switch for Power Operated Doors: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## **2.7 CURTAIN ACCESSORIES**

- A. Smoke Seals for Fire-Rated and Smoke-Rated Doors: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Push/Pull Handles for Manual Doors: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- C. Automatic-Closing Device for Fire-Rated or Smoke-Rated Coiling Doors: Equip each fire-rated door with an automatic-closing device that is inoperative during normal door operations and that has a governor unit complying with NFPA 80 and an easily tested and reset release mechanism designed to be activated by the following:

1. Building fire-detection and -alarm systems and manufacturer's standard door-holder-release devices. Resetting of spring tension or mechanical dropouts shall not be required. Upon restoration of power or clearing of the alarm signal, doors shall immediately reset by opening with the push button.
- D. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal:
1. Stainless Steel: 0.062 in (1.59 mm) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
  2. Galvanized Steel: Nominal 0.064 in (1.63 mm) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653 / A 653M.
- E. Integral Metal Sill: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with No. 4 finish.

## **2.8 COUNTERBALANCING 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, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in/ft. (2.5 mm/m) of span under full load.
- C. Spring Balance: 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.
- 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.

## **2.9 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, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
  2. Provide 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.
1. Standard Duty: Up to 25 cycles per hour and up to 90 cycles per day.



- C. Door Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft, gear-head hoist-type door operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor level disconnect.
- D. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or considering service factor.
  - 1. Type: Polyphase, medium-induction type.
  - 2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
  - 3. Coordinate wiring requirements and electric characteristics of motors with building electrical system.
  - 4. Interior Grade Units: Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
  - 5. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 6. 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 Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
  - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
    - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
- G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open", "Close", and "Stop". Locate on interior side adjacent to door.
  - 1. Interior-Grade Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  - 2. Exterior-Grade Units: Full-guarded, standard-duty, surface-mounted, weatherproof type; NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

## **2.10 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.11 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. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: No. 4.
- C. Bright, Cold-Rolled, Unpolished Finish: No. 2B.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF OVERHEAD COILING DOORS**

- 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, 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 regulatory requirements for accessibility.
- D. Fire-Rated and Smoke-Rated Doors: Install doors in corresponding fire-rated frames according to NFPA 80.
- E. Smoke-Control Doors: Install doors according to NFPA 105.
- F. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.6 STARTUP SERVICE AND DEMONSTRATION**

- A. Engage manufacturer's qualified technical representative to perform startup service and to train Owner's maintenance personnel as specified below.
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Fire-Rated and Smoke-Rated Doors:
    - a. Test door opening when activated by detector or fire-alarm system as required. Reset door-opening mechanism after successful test.
    - b. Test automatic self-opening mechanism when activated by smoke detector, emergency push-button station, fire alarm or power failure. Reset self-opening mechanism after successful test.

- B. Engage manufacturer's qualified technical representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Include procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.

### **3.7 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.

### **3.8 ARCHITECTURAL METAL FINISH SCHEDULE**

- A. Color and Gloss: Match sample accepted by Architect.

**END OF SECTION**

## SECTION 083323

### OVERHEAD COILING DOORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Overhead coiling doors and supplementary items necessary for installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, dimensions of individual components, profiles for curtain components, installation instructions, and recommendations for maintenance.
  - 2. Power Operated Units: Include rated capacities, operating characteristics, and electrical characteristics. Include nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams for Power Operated Units: For power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes. Include similar Samples of accessories involving color selection.
- D. Samples for Verification Purposes: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Door Curtain Slats: 12 in (300 mm) square.
  - 2. Bottom Bar: 6 in (150 mm) long.
  - 3. Guides: 6 in (150 mm) long.
  - 4. Brackets: 6 in (150 mm) square.
  - 5. Hood: 6 in (150 mm) square.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".

- C. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: To include in maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  - 3. Record discussions, including decisions and agreements, and prepare report.

#### **1.7 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

1. The Cookson Company.
2. Cornell Iron Works, Inc.
3. McKeon Rolling Steel Door Company, Inc.
4. Overhead Door Corporation.
5. Raynor Garage Doors.
6. Wayne-Dalton Corporation.
7. Windsor Republic Doors.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles. 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.

### **2.4 OVERHEAD COILING DOOR MATERIALS AND CONSTRUCTION**

- A. Door Curtains: Fabricate overhead coiling door curtain of interlocking metal slats 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. Exterior Units:
  - a. Galvanized Steel Door Curtain Slats: Hot-dip zinc-coated (galvanized) complying with ASTM A 123 (ASTM A 123M), or electrogalvanized complying with ASTM A 653 (ASTM A 653M), and phosphatized before fabrication; nominal sheet thickness (coated) of 0.028 in (0.7 mm) as required to meet performance requirements.
  - b. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.

- c. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Endlocks: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
  - 1. Exterior Doors: Provide windlocks.
- C. Bottom Bar: Manufacturer's standard consisting of two angles, each not less than 1-1/2 in by 1-1/2 in by 1/8 in (38 mm by 38 mm by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain and a continuous bar for holding windlocks.

## **2.5 HOOD**

- 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 project beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Material: Match hood material with that of door curtain slat material and as follows:
    - a. Galvanized Steel: Nominal 0.028 in (0.7 mm) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653 / A 653M.
  - 2. Locations: Provide at door units where coiled curtain and operating mechanisms are exposed and not concealed in ceiling or soffit.

## **2.6 LOCKING DEVICES**

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: Provide cylinders specified in Division 08 Section "Door Hardware".
- B. Chain Lock Keeper: Suitable for padlock.
- C. Safety Interlock Switch for Power Operated Doors: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

## **2.7 CURTAIN ACCESSORIES**

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
  - 1. At door head, use 1/8 in (3 mm) thick, replaceable, continuous sheet secured to inside of hood.
  - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8 in (3 mm) thick seals of flexible vinyl, rubber, or neoprene.



## 2.8 COUNTERBALANCING 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, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in/ft. (2.5 mm/m) of span under full load.
- C. Spring Balance: 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.
- 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.

## 2.9 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, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Comply with NFPA 70.
  - 2. Provide 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.
  - 1. Standard Duty: Up to 25 cycles per hour and up to 90 cycles per day.
  - 2. Heavy Duty: 25 or more cycles per hour and more than 90 cycles per day.
- C. Door Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft, gear-head hoist-type door operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor level disconnect.
- D. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or considering service factor.
  - 1. Exterior-Grade Units: Provide totally enclosed, non-ventilated or fan-cooled motors, fitted with plugged drain, and controller with NEMA ICS 6, Type 4 enclosure for exterior location.
- 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 Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
  - 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
    - a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.
- G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open", "Close", and "Stop". Locate on interior side adjacent to door.
  - 1. Exterior-Grade Units: Full-guarded, standard-duty, surface-mounted, weatherproof type; NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- L. Self-Opening Mechanism: Automatic release mechanism triggered by smoke detector, emergency push-button station, fire alarm or power failure. When activated, the door self opens by means of a fail-safe operator to the fully open position without the need of power operation or battery backup systems. When the emergency push-button is reset, and the alarm is cleared and power is restored, the door will operate normally.

## **2.10 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.11 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.
  - 1. Color and Gloss: As scheduled or as indicated in Design Selections.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF OVERHEAD COILING DOORS**

- 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, 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 regulatory requirements for accessibility.
- D. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.6 STARTUP SERVICE AND DEMONSTRATION**

- A. Engage manufacturer's qualified technical representative to perform startup service and to train Owner's maintenance personnel as specified below.
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Engage manufacturer's qualified technical representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Include procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.

### **3.7 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.

### **3.8 ARCHITECTURAL METAL FINISHES SCHEDULE**

- A. Color and Gloss: Match sample accepted by Architect.

END OF SECTION

## SECTION 08 34 00

### SPECIAL FUNCTION DOORS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section includes:
  - 1. Interior Aluminum-Framed Top-Hung Sliding Doors
- B. Related Sections:
  - 1. Section 08 14 16 – Flush Wood Door

##### 1.03 REFERENCES

- A. ANSI – American National Standards Institute
  - 1. ANSI 156.18 Materials and Finishes
  - 2. ANSI A117.1 Specifications for making buildings and facilities usable by physically handicapped people.
- B. BHMA – Builders Hardware Manufacturers Association
- C. DHI – Door and Hardware Institute
- D. NFPA – National Fire Protection Association
  - 1. NFPA 80 – Fire Doors and Windows
  - 2. NFPA 101 – Life Safety code
  - 3. NFPA 105 – Smoke and Draft Control Door Assemblies
  - 4. NFPA 252 – Fire Tests of Doors Assemblies
- E. AWS – Architectural Woodwork Standards

##### 1.04 SUBMITTALS

- A. Comply with Section 01 33 00 – Submittal Procedures

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- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show required blocking by others.
- D. Samples: Submit manufacturer's samples of the following sliding door components:
  - 1. Door veneer or laminate sample.
  - 2. Aluminum Frame finish sample.
- E. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- F. Warranty Documentation: Submit manufacturer's standard warranty.
- G. Test Reports: Submit acoustical reports or UL1784 as applicable.

#### **1.05 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and doors.
- B. Source: Obtain sliding aluminum framed doors and hardware from single source.
- C. Manufacturer's Qualifications: Manufacturer regularly engaged for past 5 years in manufacture of sliding doors similar to that specified.

#### **1.06 PERFORMANCE**

- A. Aluminum perimeter frames with integral acoustic seals.
- B. Soft self-closing mechanism integrated with top track.
- C. Concealed door guide.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Notify manufacturer immediately of any shipping damage.
- C. Storage and Handling Requirements:
  - 1. Store and handle materials in accordance with manufacturer's instructions.
  - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

3. Store materials in clean, dry area indoors.
4. Protect materials and finish during storage, handling, and installation to prevent damage.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

- 1) KI System
- 2) Algoma Hardwoods, Inc.
- 3) Construction Specialties, Inc. (C/S Group)
- 4) Eggers Industries.
- 5) Marshfield Door Systems, Inc.
- 6) Mohawk Flush Doors, Inc.; a Masonite Company.
- 7) Oshkosh Architectural Door Company.
- 8) VT Industries Inc.

### **2.02 INTERIOR SLIDING ALUMINUM-FRAMED DOORS AND PARTITIONS**

- A. Manufacturer:
1. Scheduled Manufacturer: ExamSlide™ High Performance Barn (Sliding) Door System by AD Systems.
  2. Acceptable Substitute: No Substitution.
- B. Specified Wall Thickness: Refer to Drawings.
- C. Frame Profiles: Extruded aluminum frame "wrap" frame with integral vertical jamb (stile pocket).
- D. Finish:
1. Standard: Painted Hardcoat (Kynar) Finish. Meets AAMA 2604 Standard
  2. Colors: Select from Manufacturer standard colors approved by the Architect.
- E. Door Leafs. All Doors to be factory machined for hardware including pilot and function holes.
1. 1-3/4" Flush Wood Door: Reference Spec Section 08200 Wood Doors or other section as applicable.
    - a. Standard stile widths are 6" with a 10" bottom rail.
  2. Aluminum Stile & Rail Door: 3-1/2" stiles plus 1/2" stop.

- a. 10" bottom Rail.
- 3. Other 1-3/4" Doors.
- F. Door Components:
  - 1. Single Top Track: KI Systems extruded aluminum track by AD Systems
  - 2. Valances: Extruded aluminum with integral end caps
    - a. Standard square valance.
  - 3. Top Rollers: tandem nylon roller sized to match door weight
  - 4. Concealed Floor Guide: Integral Jamb floor guide by AD Systems
  - 5. Soft-Closer: Soft and self-closing damper mechanism at [one] or [both] sides of door leaf
  - 6. Handles:
    - a. KI Systems Standard Straight Pull: 12" long x 1" diameter. Finish: US32D Satin Stainless Steel.
- G. Accessories:
- H. Door Locks:
  - 1. Not Required
- I. Automatic Door Bottom for improved acoustical performance
- J. Additional hardware functionality can be accommodated. Please contact AD Systems with your hardware requirements and we evaluate system compatibility and create specification language.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine wall openings to receive sliding doors for plumb, level, and square. Note: Finish door operation will be affected by out of tolerance framing.
- B. Verify dimensions of wall openings.
- C. Examine surfaces to receive top and bottom guide.
- D. Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors.
- E. Do not begin installation until unacceptable conditions are corrected.
- F. Base of door side to be flush or minimal. Rubber Base acceptable.



### **3.02 INSTALLATION**

- A. Install sliding doors in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Install sliding doors plumb, level, square, and in proper alignment.
- C. Install sliding doors to close against walls without gaps
- D. Install sliding doors to open and close smoothly.
- E. Anchor sliding doors securely in place to supports. Required: Fire treated 2 x 6 blocking required full length of track.

### **3.03 ADJUSTING**

- A. Adjust sliding doors for proper operation in accordance with manufacturer's instructions.
- B. Adjust sliding doors to operate smoothly without binding.
- C. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

### **3.04 CLEANING**

- A. Clean sliding doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage materials or finish.

### **3.05 PROTECTION**

- A. Protect installed sliding doors from damage during construction.

**END OF SECTION**

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**08 3400-6**

## SECTION 08 4400

### GLAZED ALUMINUM FRAMING SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Glazed aluminum framing systems and supplementary items necessary for installation.
  - 1. Conventionally glazed aluminum curtain wall and window wall systems.
  - 2. Aluminum entrance doors.

##### 1.2 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines for Aluminum Entrance Doors: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".

##### 1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.
- B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
- C. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- D. Coordination of Work:
  - 1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.

2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  1. Prepared by manufacturer, not installer.
  2. Include typical unit elevations at 1/2 in (12 mm) scale and details at full scale.
  3. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  4. Indicate where and how the system deviates from Contract Documents.
  5. Shop drawings shall contain seal of a professional engineer currently registered in licensing jurisdiction of the project and a written statement that the framing system conforms to project requirements, applicable codes, and specified conditions.
  6. Provide for information only, material properties and other information needed for structural analysis including computations, prepared, signed, or, and sealed by a professional engineer licensed to practice in the jurisdiction where the project is located.
    - a. Calculations shall include but not limited to the following:
      - 1) Section properties for framing members.
      - 2) Analysis of framing members.
      - 3) Analysis of anchors and embedded anchors in concrete structure.
      - 4) Analysis of stress in structural silicone.
      - 5) Analysis of glass thicknesses and strength.
  2. Submittal shall contain statement explaining how proposed system design will accommodate infiltrated and condensate water.
  3. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
  4. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum framing systems, showing the following:
    - a. Mullion details, including reinforcement and stiffeners.
    - b. Joinery details, including concealed welds.

- c. Anchorage.
  - d. Expansion provisions.
  - e. Glazing details.
  - f. Flashing and drainage details.
  - g. Weather-stripping details.
  - h. Thermal-break details.
  - i. Weatherseals within curtainwall framing joinery.
  - j. Perimeter weatherseals and structural seals.
  - k. Interface with other building construction.
  - l. De-glazing and re-glazing procedures.
  - m. Identification and detail of perimeter fire containment system.
5. Submit insert/embed drawings including layout and enlarged details. Include detail and engineering calculations for field modifications due to location and/or omitted inserts/embeds.
- B. Hardware Schedule for Aluminum Entrance Doors: Prepared by or under the supervision of supplier, detailing fabrication and assembly of aluminum entrance door hardware, as well as 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.
- C. Samples for Verification Purposes: Provide pairs of samples for each finish type and color on 12 in (300 mm) long sections of extrusions or formed shapes and on 6 in (150 mm) squares of aluminum sheet or plate. Include 2 or more units in each sample set showing the extreme limits of variations expected in color and texture of finish.
- D. Welding Certifications: Qualification certificates required by "Quality Assurance" Article. Include names of firms and personnel certified.
- E. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
- 1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- F. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- G. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- H. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- I. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its products and systems are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.

- J. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- K. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

## 1.2 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.
  - 1. Structural-Sealant Glazing: For structural-sealant glazing, include ASTM C 1401 recommendations for post-installation-phase, quality-control program.

## 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Materials: Provide extra materials to designated storage area as directed by Owner. Materials shall comply with same requirements for materials used in construction:
  - 1. One percent of total square footage of each glass type in sizes determined by the Architect and Consultant.
  - 2. Three sets of entrance door operable hardware.
  - 3. 500 ft of typical glazed aluminum framing system glazing gaskets.
  - 4. Two gallons of each architectural metal finish coating system and color for touch up.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
    - a. Subcontractor Responsibility: Work included in this Technical Section shall be performed by a qualified single subcontractor solely responsible for engineering, fabrication and installation of the Work.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS qualification requirements and the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum".

- C. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
  - 1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.
- D. Accessible Entrances for Aluminum Entrance Doors: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Structural-Sealant Glazing: Comply with ASTM C 1401 "Guide for Structural Sealant Glazing" for design and installation of glazed aluminum wall systems utilizing structural-sealant glazing.
  - 1. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
  - 2. Comply with ASTM C 1135 Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
- F. Preconstruction Testing Service: Provide glazed aluminum curtain walls that comply with test-performance requirements indicated, as evidenced by reports based on Project-specific preconstruction testing by a qualified testing agency.
  - 1. Refer to Division 01 Section "Testing Mock-up For Building Enclosure Systems".
- G. Preconstruction Sealant Testing: Perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition.
  - 1. Test a minimum five production-run samples each of metal, glazing, and other material.
  - 2. Prepare samples using techniques and primers required for installed assemblies.
  - 3. Perform tests under environmental conditions that duplicate those under which assemblies will be installed.
  - 4. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.
- H. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
  - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  - 2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.

3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

#### **1.5 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  3. Record discussions, including decisions and agreements, and prepare report.

#### **1.6 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

#### **1.7 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.



## 1.8 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
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: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 5 years from date of Substantial Completion
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.
- C. Factory Applied Finish Warranty for Anodic Finishes: Furnish manufacturer's written warranty signed by an authorized representative using manufacturer's standard form agreeing to repair finish or replace work which exhibits finish defects. "Defects" is defined to include but not limited to deterioration or failure of finish to perform as required.
1. Warranty Period: Manufacturer shall warrant the installation to be free from finish defects for a period of 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
1. Baker Metal Products Inc.
  2. Bruce Wall Systems Corporation.
  3. C.R. Laurence - US Aluminum.
  4. EFCO Corporation, a Pella Company.
  5. Harmon Inc.

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6. Kawneer North America; an Alcoa Company.
7. Oldcastle BuildingEnvelope.
8. YKK AP America Inc.

B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Curtain Wall System; Captured Glazing: Reference exterior elevation drawing.
2. Window Wall System; Captured Glazing: Reference exterior elevation drawing.
3. Standard-Duty Aluminum Entrance Door System; Medium Stile: Reference exterior elevation drawing.

## **2.2 MATERIALS, GENERAL**

A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## **2.3 PERFORMANCE REQUIREMENTS**

A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.

B. Design Loads: Engineer to withstand design loads including but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable local building codes, and as indicated.

1. Structural Movement: Engineer to withstand movements of structure including, but not limited to: drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads.

a. Live Load Deflection: System shall accommodate plus or minus 3/8 in (10 mm) differential vertical deflection of floors.

C. Structural Test Performance: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence 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.

D. Deflection of Framing Members:

1. Deflection Normal to Glazing Plane: Limited to 1/175 of clear span for spans up to 13 ft 6 in (4050 mm) and to 1/240 of clear span plus 1/4 in (6 mm) for spans more than 13 ft 6 in (4050 mm) or 1 in (25 mm), whichever is less.

- a. Exceptions:
    - 1) Net deflection of spans with one glass lite more than 120 in (3000 mm) in height limited to not more than 3/4 in (18.75 mm) regardless of overall span.
    - 2) Where a sealant joint occurs between a framing member and a relatively stiff building element, framing member deflection not more than 1/2 of nominal joint width, or less if required by sealant manufacturer.
  - b. Span is defined as the distance between anchor centerline.
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 in (3 mm).
    - a. Operable Units (Doors or Windows): Provide a minimum 1/16 in (1.6 mm) clearance between framing members and operable units.
  3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
  4. Window Sill Extension Deflection: The center deflection of the window sill extension trim, when subjected to a 250 pound (113 Kg) vertical concentrated load, shall not exceed 1/4 in (6 mm). No permanent deformation is allowed when load is removed.
  5. Gypsum Board Deflection: Deflection of framing members in a direction normal to wall plane is limited to 1/360 of clear span, 3/4 in (19 mm) maximum, where gypsum board surfaces are subject to bending.
- E. Building Maintenance Equipment: Engineer units supporting building maintenance equipment to resist pull-out and horizontal shear forces transmitted from equipment.
  - F. Seismic Performance: Withstand the effects of earthquake motions.
  - G. Water Penetration under Static Pressure for Curtain Wall and Window Wall Systems: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sf.
  - H. Water Penetration under Dynamic Pressure for Curtain Wall and Window Wall Systems: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sf.
    1. 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 that is drained to exterior.

- I. Thermal Movements: Engineer products and systems to accommodate thermal movements of supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses, damaging loads on fasteners, failure of operating units to function properly, and other detrimental effects.
  - 1. Temperature Change (Range): 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.
  
- J. Energy Performance: Glazed aluminum curtain wall systems shall have certified and labeled energy performance ratings in accordance with NFRC.
  - 1. Curtainwall and Storefront Glazing Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sf (0.30 L/s/sm) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sf (300 Pa).
  - 2. Exterior Entrance Door Air Infiltration: Maximum air leakage through glazed entrance doors of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) .
  - 3. Condensation Resistance: Fixed glazing and framing system shall have thermal break construction and NFRC-certified condensation resistance rating determined according to NFRC 500.
    - a. AAMA Condensation Resistance (CRF): In addition to condensation resistance rating determined according to NFRC 500, provide glazed aluminum wall system with thermally improved construction that has been tested in accordance with AAMA 1503 and certified by the manufacturer to provide a condensation resistance factor (CRF) of not less than 55.
  
- K. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.

## 2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Sheet and Plate: ASTM B 209 / B 209M.
  - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 / B 221M.
  - 3. Extruded Structural Pipe and Tubes: ASTM B 429 / B 429M.
  - 4. Structural Profiles: ASTM B 308 / B 308M.
  - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
  
- B. Steel Internal Reinforcement: Shapes and sizes to suit installation meeting delegated engineered performance requirements, as indicated on Shop Drawings.
  - 1. Structural Shapes, Plates, and Bars: ASTM A 36 / A 36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A 1008 / A 1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A 1011 / A 1011M.

4. 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 according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

## **2.5 FRAMING SYSTEM**

- A. Framing Members: Manufacturer's standard formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Fabrication Method: Factory-fabricated unitized system.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
  1. Use Series 300 Stainless Steel fasteners for joining framing members and fasteners located in wet areas.
  2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  3. Reinforce members as required to receive fastener threads.
  4. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
  5. Window Wall and Storefront: Furnish heavy duty aluminum sill pan with integral welded end dams, typical.
- D. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish and are 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 A 123 / A 123M or ASTM A 153 / A 153M requirements.
- E. Concealed Flashing: Dead-soft, 0.018 in (0.45 mm) thick stainless steel, ASTM A 240 / A 240M of type recommended by manufacturer.
- F. Framing System Gaskets and Sealants: Refer to Division 08 Section "Glazing".
  1. EPDM Gaskets: EPDM shall be isolated from direct contact with silicone; including but not limited to the secondary perimeter silicone seal of insulating glass units.

## **2.6 GLAZING**

- A. Glazing: Provide glass of types and thicknesses indicated. Fabricate glass to sizes required for openings indicated with edge clearances and tolerances complying with manufacturer's recommendations. Comply with Division 08 Section "Glazing".

- B. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: Manufacturer's standard permanent, non-migrating types compatible with sealants and suitable for joint movement and assembly performance requirements. Comply with Division 08 Section "Glazing".
  - 1. Silicone Sealant Compatibility: When in direct contact with silicone sealants, gaskets, spacers and setting blocks shall be heat cured silicone rubber based material which is chemically compatible and with sufficient hardness for the purpose intended and approved in writing by the glazing and curtain wall manufacturers.
- C. Glazing Sealants: As recommended by manufacturer for joint type.
  - 1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 50, neutral-curing silicone formulation compatible with system components with which it comes in contact; and recommended by weatherseal-sealant and curtain-wall manufacturers for this use.
    - a. Joint Movement Capability: Accommodates a 50 percent increase or decrease in joint width at time of application when measured according to ASTM C 719.
    - b. Color: Black, unless otherwise indicated.
  - 2. Bond-Breaker Tape: Manufacturer's standard tetrafluoroethylene-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

## 2.7 ALUMINUM ENTRANCE DOOR SYSTEMS

- A. Heavy-Duty Aluminum Entrance Doors: Manufacturer's heavy-duty manual-swing operation entrance door system designed to coordinate with glazed aluminum wall framing system.
  - 1. Door Construction: 2 in (50.8 mm) overall thickness, with minimum 0.188 in (3.2 mm) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded.
  - 2. Door Design: Medium stile; 3-1/2 in (87 mm) nominal width at vertical stiles.
    - a. Accessible Doors: Smooth surfaced for width of door in area within 10 in (250 mm) above floor or ground plane.
  - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets. Provide non-removable glazing stops on outside of door.
  - 4. Door Hardware:
    - a. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 in (12 mm). Provide cutouts coordinated for operating hardware, with anchors and jamb clips.
    - b. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
    - c. Balance of Door Hardware: As specified in Division 08 Section "Door Hardware".

## 2.8 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of glazed aluminum framing systems, as specified in Division 07 Section "Joint Sealants".
- B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30 mils (0.762 mm) thickness per coat.
- C. Maintenance Equipment Anchors: As specified in Division 11 Section "Building Maintenance Equipment".
- D. Cleaning Agent and Cloth: As recommended by structural-sealant manufacturer.
- E. Linings, Spacers and Sleeves: At dynamic or moving joints, provide type and materials recommended by manufacturer.

## 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. Welds shall be of adequate strength and durability, with jointing tight, flush, smooth and clean. Weld behind finished surfaces so as to cause no distortion and/or discoloration on the finished side. 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 is 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. Provide minimum clearances and depth of glazing packets as recommended by glass manufacturer for thickness and type of glass indicated.
    - a. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural-sealant cures.
  - 6. Fasteners, anchors, and connection devices that are concealed from view.
  - 7. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum framing systems to exterior.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. For Factory-Assembled and Glazed Frame Units:

1. Rigidly secure non-movement joints.
  2. Seal joints watertight unless otherwise indicated.
  3. Factory-install glazing to comply with requirements in Division 08 Section "Glazing".
  4. Structural-Sealant Units: Prepare surfaces that will contact structural-sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- F. Aluminum Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
  2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Aluminum 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. Aluminum 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 according to Shop Drawings.

## **2.10 FINISHES, GENERAL**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Concealed members may be mill finish, providing that they cannot be seen through the glass, do not contact any structural silicone or are not continually exposed to water immersion.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of accepted 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 accepted Samples and are assembled or installed to minimize contrast.

## **2.11 ALUMINUM FINISHES**

- A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.



1. Selections: As scheduled or as indicated on exterior elevation drawing(s).
- B. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Provide dry film thickness, primers, color coats and clear coats required to comply with performance requirements and warranty periods indicated.
  1. PVDF Fluoropolymer Finish: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
  2. FEVE Fluoropolymer Finish: Fluoropolymer finish complying with AAMA 2605 and containing 100 percent fluorinated ethylene vinyl ether (FEVE) resin in color coat.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
  1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
  2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

#### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
  1. Furnish inserts for setting in concrete forming, and similar work required to support glazed aluminum wall system.

2. Field measure and verify governing dimensions, including floor elevations, floor-to-floor heights, minimum clearance between wall system and structural frames and other permissible dimensional tolerances in building frame.

### **3.4 INSTALLATION OF GLAZED ALUMINUM FRAMING SYSTEMS**

#### **A. General:**

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure non-movement joints.
4. Install anchors with separators and isolators to prevent impediments to movement of joints.
5. Do not cut, trim, weld or braze component parts during erection, in any manner which would damage finish, decrease strength or result in visual imperfection or failure in performance of construction.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints within glazed aluminum framing system according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum framing systems to exterior.

C. Set continuous sill members and flashing in full sealant bed and install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades, and without warp or rack. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and fillers. Maintain minimum clearance of **1 in (25 mm)** between inside face of framing system and outside face of building structure.

E. Aluminum Entrance Doors: Install 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 according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

F. Install glazing as specified in Division 08 Section "Glazing".

### **3.5 ERECTION TOLERANCES**

A. Erection Tolerances: Install to comply with the following non-accumulating maximum erection tolerances:

1. Plumb: 1/8 in per 10 ft (3 mm per 3 m); 1/4 in per 40 ft (6 mm per 12 m).
2. Level: 1/8 in per 10 ft (3 mm per 3 m); 1/4 in per 40 ft (6 mm per 12 m).
3. Alignment:
  - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 in (12 mm) wide, limit offset from true alignment to 1/16 in (1.5 mm).
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 in (12 to 25 mm) wide, limit offset from true alignment to 1/8 in (3 mm).
  - c. Where surfaces are separated by reveal or protruding element of 1 in (25 mm) wide or more, limit offset from true alignment to 1/4 in (6 mm).
4. Location and Plane: Limit variation from plane to 1/8 in per 12 ft (3 mm per 3.6 m); 1/2 in (12 mm) over total length.

### **3.6 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Testing Agency: Engage a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.
- C. Prepare test and inspection reports.

### **3.7 ADJUSTING OF ALUMINUM ENTRANCE DOORS**

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
  1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 in (75 mm) from the latch, measured to the leading door edge.

- 3.8 **ARCHITECTURAL METAL FINISH SCHEDULE:** Refer to Exterior Elevation drawings.

**END OF SECTION**

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

**GLAZED**  
**ALUMINUM**  
**FRAMING**  
**SYSTEM**  
**08 4400 - 18**

## SECTION 08 5619

### SLIDING PASS WINDOWS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes sliding pass windows and supplementary items necessary to complete work required for their installation.
- B. Related Section:
  - 1. Division 08 Section "Overhead Coiling Doors" for roll down fire-rated counter shutters for use with non-fire-rated sliding pass windows located at fire-rated partitions.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Approvals: Submit Florida Product Approval or Product Control Notice of Acceptance (NOA) issued by Miami-Dade County Building Code Compliance Office (BCCO) or other product approval acceptable to authorities having jurisdiction for systems used at exterior of building.
- B. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

##### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.

##### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.6 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Windborne-Debris-Impact-Resistance Performance: Comply with impact resistance testing requirements for Wind Zone.

### **2.3 NON-FIRE RATED HORIZONTAL FRAMELESS SLIDING WINDOW (TYPE SW-1)**

- A. Configuration: Two 1/4 in (6 mm) operable window panes with top and bottom tracks. Recess tracks unless indicated otherwise.
- B. Basis of Design (Product Standard): EPCO; Packaged Glass Door Track Assemblies, Assembly #16; Size(s) as indicated on drawings.
  - 1. Clear anodized aluminum frame finish.
  - 2. Manufacturer's standard ratchet lock with bright chrome finish.
    - a. EPCO Part No. G04-C; include side jambs at both sides (Part No. 730)
  - 3. 1/4 in (6 mm) thick, clear tempered glass windows.
- C. Manufacturers:
  - 1. EPCO
  - 2. Hafele
  - 3. Knape & Vogt

### **2.4 NON-FIRE-RATED HORIZONTAL FRAMED SLIDING WINDOW (TYPE SW-2)**

- A. Two Sliding Panes: Two 1/4 in (6 mm) operable window panes, top hung on nylon guides with frames top and sides; no sill:

1. Manufacturer and Product: Nissen & Co., Inc.; Sliding Serving Windows, Series BP; Size(s) as indicated on drawings.
  - a. Clear anodized aluminum frame finish.
  - b. Manufacturer's standard pin screw lock.
  - c. 1/4 in (6 mm) thick, clear tempered glass windows.
  
- B. One Sliding Pane; One Fixed Pane: Two 1/4 in (6 mm) window panes (one operable; one fixed), top hung on nylon guides with frames top and sides; no sill:
  1. Manufacturer and Product: Nissen & Co., Inc.; Sliding Serving Windows, Series E; Size(s) as indicated on drawings.
    - a. Clear anodized aluminum frame finish.
    - b. Manufacturer's standard pin screw lock.
    - c. 1/4 in (6 mm) thick, clear tempered glass windows.

## **2.5 FIRE-RATED HORIZONTAL FRAMED SLIDING WINDOW, (TYPE SW-3)**

- A. Manufacturer and Product: Nissen & Co., Inc.; Steel Sliding Fire Windows; Size(s) as indicated.
  1. Steel: Frame and sash shall be fabricated of 16-gage cold rolled steel, conforming with ASTM A366
  2. Weatherstripping: Sliding slash panel shall be fully weatherstripped with silicone treated wool pile or equivalent and vinyl.
  3. Finish: As selected from manufacturers standard finishes.
  4. Glazing: Factory glazed with clear 1/4 in (6 mm) thick wire glass. Wire to be minimum of 24 gage with maximum opening of one square inch and comply per UL requirements. Glass to comply with ANSI Z97.1 and ASTM C1036.
  5. Hardware: Sliding panels shall be furnished with a positive latching 1/8 in (3 mm) thick steel latch, attached to the bottom rail; engaging on a 1/4 in (6 mm) thick keeper that is surface mounted to the sill member.
    - a. Self-Closing Latch: Provide a spring actuated automatic closing device used in conjunction with a 160-degree fusible link assembly mounted on the unit.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Respective manufacturer/fabricator's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.

- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
- C. Preparation, General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

**END OF SECTION**



## **SECTION 08 71 00**

### **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 and electrified door hardware for:
    - a. Swinging doors.
    - b. Sliding doors.
    - c. Gates.
  - 2. Electronic access control system components, including:
    - a. Biometric access control reader.
    - b. Electronic access control devices.
  - 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
  - 4. Lead-lining door hardware items required for radiation protection at door openings.
- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
  - 1. Windows
  - 2. Cabinets (casework), including locks in cabinets
  - 3. Signage
  - 4. Toilet accessories
  - 5. Overhead doors
- C. Related Sections:
  - 1. Division 01 Section "Alternates" for alternates affecting this section.
  - 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
  - 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
  - 4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.

5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 sections for coordination with other components of electronic access control system.

### **1.3 REFERENCES**

#### **A. UL - Underwriters Laboratories**

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

#### **B. DHI - Door and Hardware Institute**

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

#### **C. ANSI - American National Standards Institute**

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

### **1.4 SUBMITTALS**

#### **A. General:**

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

#### **B. Action Submittals:**

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
  - a. Wiring Diagrams: For power, signal, and control wiring and including:
    - 1) Details of interface of electrified door hardware and building safety and security systems.
    - 2) Schematic diagram of systems that interface with electrified door hardware.
    - 3) Point-to-point wiring.
    - 4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
  - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
  - a. Door Index; include door number, heading number, and Architects hardware set number.
  - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
  - c. Type, style, function, size, and finish of each hardware item.
  - d. Name and manufacturer of each item.
  - e. Fastenings and other pertinent information.
  - f. Location of each hardware set cross-referenced to indications on Drawings.
  - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
  - h. Mounting locations for hardware.
  - i. Door and frame sizes and materials.
  - j. Name and phone number for local manufacturer's representative for each product.
  - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
    - 1) 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 fabrication of other work that is critical in Project construction schedule.
5. Key Schedule:
  - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
  - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
  - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
  - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
  - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
    - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
  - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
  - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
  - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
  - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
  - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
  - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
  - b. Catalog pages for each product.
  - c. Name, address, and phone number of local representative for each manufacturer.
  - d. Parts list for each product.
  - e. Final approved hardware schedule, edited to reflect conditions as-installed.
  - f. Final keying schedule
  - g. Copies of floor plans with keying nomenclature
  - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
  - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

## 1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)

- a. Where no additional products or manufacturers are listed in product category, requirements for “No Substitute” govern product selection.
  2. Where products indicate “acceptable manufacturers” or “acceptable manufacturers and products”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
1. Warehousing Facilities: In Project's vicinity.
  2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
  3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
  4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
    - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Architectural Hardware Consultant Qualifications: 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 meets these requirements:
1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
  2. Can provide installation and technical data to Architect and other related subcontractors.
  3. Can inspect and verify components are in working order upon completion of installation.
  4. Capable of producing wiring diagrams.
  5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
  2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

- G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets 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 tested pressure differential of 0.3-inch wg (75 Pa) of water.
- H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
  - 2. Maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - 3. Bevel raised thresholds with 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 open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
  - 1. Attendees: Owner, Contractor, Architect, Installer, Owner's security consultant, and Supplier's Architectural Hardware Consultant.
  - 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
    - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    - b. Preliminary key system schematic diagram.
    - c. Requirements for key control system.
    - d. Requirements for access control.
    - e. Address for delivery of keys.
- L. Pre-installation 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. Inspect and discuss electrical roughing-in for electrified door hardware.
  - 4. Review sequence of operation for each type of electrified door hardware.
  - 5. Review required testing, inspecting, and certifying procedures.

M. Coordination Conferences:

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**DOOR HARDWARE**

**087100-6**

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
  - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
  - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
  - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Owner's security consultant, Architect and Contractor.
  - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
  1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
  1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
  2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
  1. Promptly replace products damaged during shipping.
  2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
  3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys to Owner by registered mail or overnight package service.

## 1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. 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.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. 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.
- F. Direct shipments not permitted, unless approved by Contractor.

## 1.8 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. Warranty Period: Years from date of Substantial Completion, for durations indicated.
    - a. Closers:
      - 1) Mechanical: 30 years.
    - b. Automatic Operators: 2 year.
    - c. Exit Devices:
      - 1) Mechanical: 3 years.
      - 2) Electrified: 1 year.
    - d. Locksets:
      - 1) Mechanical: 3 years.
      - 2) Electrified: 1 year.
    - e. Key Blanks: Lifetime
  - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

## 1.9 MAINTENANCE

- A. Maintenance Tools:



1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
  1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

### **2.2 MATERIALS**

- A. Fasteners
  1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
  2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
  4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- C. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
  2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
  3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
  4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

### 2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series
2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series

B. Requirements:

1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
  - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
  - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
  - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
  - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
11. Provide mortar guard for each electrified hinge specified.
12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

## **2.4 CYLINDRICAL LOCKS – GRADE 1**

### **A. Manufacturers and Products:**

1. Scheduled Manufacturer and Product: Corbin-Russwin – Mechanical; Schlage ND Series - Electrified
2. Acceptable Manufacturers and Products: No Substitution.

### **B. Requirements:**

1. Provide cylindrical locks conforming to the following standards and requirements:
  - a. ANSI/BHMA A156.2 Series 4000, Grade 1.
  - b. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
  - c. Florida Building Code (ASTM E330, E1886, E1996) and Miami Dade (TAS 201, 202, 203) requirements for hurricanes.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
  - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
  - b. Cycle life - tested to minimum 10 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
  - a. Lever Design: Dane.
  - b. Knurled finishes at openings serving rooms considered to be hazardous.

## 2.5 EXIT DEVICES

### LOW PROFILE PUSH BAR EXIT DEVICES

#### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 99-series.
2. Acceptable Manufacturer and Product: No Substitution.

B. The maximum exit device projection shall be a maximum of 3-1/16" when activated. The exit device bar shall have an average minimum thickness of .201". The pushpad surface shall be constructed of stainless steel; pushpads with plastic or Lexan coatings shall not be acceptable. Nylon bearings and stainless steel springs shall be used for long life and durability. Only torsion or compression springs are acceptable. Extension type springs are not acceptable. All device covers shall be of cast brass, deep drawn steel or stainless steel. Latchbolts shall be of stainless steel and shall have a deadlocking latch for extra security, except at full-glass or two-light glass doors requiring narrow stile device. Mounting screws shall be concealed to deter tampering. All ferrous parts shall be zinc coated to prevent rusting.

C. Single point, one quarter turn hex dogging shall be standard on panic listed devices. Optional key cylinder dogging shall be available, and furnished if so indicated in the hardware sets, on panic listed devices. Devices with hex key dogging shall be easily field converted to cylinder dogging.

D. All devices shall be listed by Underwriters Laboratories for safety as panic hardware. Fire rated devices shall be UL listed for A label and lesser class doors, 4' x 8' single and 8 x 8' pair. The model number shall be located on the end cap; devices having the model number located other than on the end cap shall not be acceptable.

E. All exit devices shall have a unitized installation feature and may be cut in the field to size. Devices shall be closed on all sides with no pinch points. The pushpad shall be designed to prevent pinching of the fingers when depressed.

F. Exit Device trim to be throughbolted. Lever trim to be heavy duty forged escutcheon with free wheeling levers.

G. All exit devices shall conform to Federal Specification FF-H-1820, and be certified as meeting ANSI A156.3, Grade 1 requirements.

## 2.6 CYLINDERS

#### A. Manufacturers:

1. Scheduled Manufacturer: Corbin-Russwin
2. Acceptable Manufacturers: No Substitution

#### B. Requirements:

1. Provide permanent cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder

face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2. Replaceable Construction Cores.
  - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
    - 1) 3 construction control keys
    - 2) 12 construction change (day) keys.
  - b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

## 2.7 KEYING

- A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- C. Requirements:
  1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
    - a. Master Keying system as directed by the Owner.
  2. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
  3. Provide keys with the following features:
    - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    - b. Patent Protection: Keys and blanks protected by one or more utility patent(s).
  4. Identification:
    - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
    - b. Identification stamping provisions must be approved by the Architect and Owner.
    - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    - d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
    - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
  5. Quantity: Furnish in the following quantities.
    - a. Change (Day) Keys: 3 per cylinder/core.

- b. Master Keys: 6.

## **2.8 KEY CONTROL SYSTEM**

### **A. Manufacturers:**

1. Scheduled Manufacturer: Telkee
2. Acceptable Manufacturers: HPC, Lund

### **B. Requirements:**

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
  - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
  - b. Provide hinged-panel type cabinet for wall mounting.

## **2.9 DOOR CLOSERS**

### **A. Manufacturers and Products:**

1. Scheduled Manufacturer and Product: LCN 4040 series
2. Acceptable Manufacturers and Products: No Substitution.

### **B. Requirements:**

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
3. Closer Body: 1-1/4 inch (32 mm) diameter, with 5/8 inch (16 mm) diameter heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. OPTION LCN No Substitute: Cylinder body to have "FAST" power adjust speed dial to visually indicate spring power.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: not permitted.
8. 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.

## **2.10 DOOR TRIM**

### **A. Manufacturers:**

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

## 2.11 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
  - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
  - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
  - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

## 2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

## **2.13 DOOR STOPS AND HOLDERS**

### **A. Manufacturers:**

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

### **B. Provide door stops at each door leaf:**

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

## **2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING**

### **A. Manufacturers:**

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Reese

### **B. Requirements:**

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
  - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
  - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.



## 2.15 SILENCERS

### A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

### B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.16 FINISHES

### A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Continuous Hinges: BHMA 628 (US28)
4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
5. Protection Plates: BHMA 630 (US32D)
6. Overhead Stops and Holders: BHMA 630 (US32D)
7. Door Closers: Powder Coat to Match
8. Wall Stops: BHMA 630 (US32D)
9. Latch Protectors: BHMA 630 (US32D)
10. Weatherstripping: Clear Anodized Aluminum
11. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Prior to installation of hardware, 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. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:

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**DOOR HARDWARE**

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing door and frame for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
  - 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: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
  - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

### 3.3 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. Custom Steel Doors and Frames: HMMA 831.
  3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity 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.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
  1. Replace construction cores with permanent cores as indicated in keying section.

- J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.
- K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
  - 1. Conduit, junction boxes and wire pulls.
  - 2. Connections to and from power supplies to electrified hardware.
  - 3. Connections to fire/smoke alarm system and smoke evacuation system.
  - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
  - 5. Testing and labeling wires with Architect's opening number.
- L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
  - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. 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 may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### **3.4 FIELD QUALITY CONTROL**

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
  - 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
  - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months 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.

### 3.6 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 door hardware is without damage or deterioration at time of Substantial Completion.

### 3.7 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

### 3.8 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
- B. Hardware Sets:

Hardware Group No. 001

For use on mark/door #(s):

01-15-02A      01-15-03A      01-15-04A      01-15-05A      01-15-06A      01-15-07A

Provide each SL door(s) with the following:

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**DOOR HARDWARE**

1 EA NOTE HARDWARE BY DOOR MANUFACTURER ADS

Hardware Group No. 002

For use on mark/door #(s):

01-00-02B	01-00-02C	01-00-02D	01-00-07A	01-01-00B	01-01-00C
01-05-01B	01-05-01G	01-08-01A	01-09-00B	01-09-00C	01-09-00D
01-09-00E	01-13-00A	01-13-01A	01-15-01A	01-15-01B	01-15-01C
01-16-01B	02-17-01B	02-17-01C	02-17-01D		

Provide each RU door(s) with the following:

1 EA NOTE HARDWARE BY DOOR MANUFACTURER UNK

Hardware Group No. 103

For use on mark/door #(s):

01-04-04	01-07-03	01-09-16	01-09-17	01-12-05	01-12-06
01-15-12	01-16-01A	01-16-05	01-16-08	01-16-09	01-16-10
01-16-12	02-17-39				

Provide each SGL door(s) with the following:

3 EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1 EA	OFFICE/ENTRY LOCK	CL3551 IC6 NZD W/ CT6		C-R
1 EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1 EA	WALL STOP	WS406/407CCV	626	IVE
1 EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 103A

For use on mark/door #(s):

02-17-25	02-17-28
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Provide each SGL door(s) with the following:

3 EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1 EA	OFFICE/ENTRY LOCK	CL3551 IC6 NZD W/ CT6		C-R
1 EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1 EA	WALL STOP	WS406/407CCV	626	IVE
1 EA	SEAL	SEAL BY DOOR/FRAME MANUFACTURER		UNK

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DOOR HARDWARE

087100-21

Hardware Group No. 103W

For use on mark/door #(s):

01-08-14      01-08-15      01-11-03      01-11-04      01-11-06      01-11-07

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	OFFICE/ENTRY LOCK	CL3551 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 201

For use on mark/door #(s):

01-00-09      01-05-02      01-05-05      01-08-13      01-12-00      01-12-04  
01-13-10      01-13-11      01-15-10      01-16-04      02-05-11      02-05-12  
02-17-08      02-17-09      02-17-29      02-17-30      02-17-34A      02-17-34B  
02-17-46

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	STOREROOM	CL3557 IC6 NZD W/ CT6	626	C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 201W

For use on mark/door #(s):

01-08-03      01-09-14      01-13-06

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	STOREROOM	CL3557 IC6 NZD W/ CT6	626	C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

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**DOOR HARDWARE**

**087100-22**

Hardware Group No. 207

For use on mark/door #(s):

01-07-10

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	STOREROOM	CL3557 IC6 NZD W/ CT6	626	C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 207W

For use on mark/door #(s):

01-04-02

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	STOREROOM	CL3557 IC6 NZD W/ CT6	626	C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 301

For use on mark/door #(s):

01-02-02	01-02-03	01-02-04	01-02-05	01-02-06	01-02-07
01-15-09	01-16-03	02-17-05	02-17-06	02-17-32	02-17-33

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	PRIVACY LOCK	CL3520 NZD		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE

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**DOOR HARDWARE**

1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER
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Hardware Group No. 301W

For use on mark/door #(s):

01-00-07	01-07-05	01-07-06	01-08-04	01-09-03	01-11-01
01-11-02	01-13-03	02-17-02	02-17-03		

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	PRIVACY LOCK	CL3520 NZD		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 403SW

For use on mark/door #(s):

01-13-05

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	PASSAGE/CLOSET	CL3510 NZD	626	C-R
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 403W

For use on mark/door #(s):

01-07-07	01-07-08	01-07-09	01-07-11	01-08-05	01-09-04
01-09-05	01-09-06	01-09-11	01-10-02	01-10-03	01-10-04
01-10-05B	01-10-06B	01-10-07	01-10-08	01-10-09	01-12-01
01-12-02	01-12-03				

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	PASSAGE/CLOSET	CL3510 NZD	626	C-R
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

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**DOOR HARDWARE**

**087100-24**



Hardware Group No. 501

For use on mark/door #(s):

01-02-01	01-02-08A	01-02-08B	01-05-01A	01-06-01	01-07-12
01-09-12	01-09-13	01-09-15	01-13-00B	01-13-12	01-14-04A
01-14-04B	01-16-02	01-16-06A	01-16-06B	01-16-07A	02-17-04A
02-17-04B	02-17-24	02-19-01B			

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	CLASSROOM LOCK	CL3555 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 501A

For use on mark/door #(s):

02-17-26

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	CLASSROOM LOCK	CL3555 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	SEAL	SEAL BY DOOR/FRAME MANUFACTURER		UNK

Hardware Group No. 501W

For use on mark/door #(s):

01-04-05	01-04-06	01-04-07	01-10-00	01-11-08
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Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	CLASSROOM LOCK	CL3555 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE

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**DOOR HARDWARE**

1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 503

For use on mark/door #(s):  
02-17-38

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	CLASSROOM LOCK	CL3555 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 503W

For use on mark/door #(s):  
01-01-01A      01-01-02A      01-01-03A      01-01-04A

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	CLASSROOM LOCK	CL3555 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 507

For use on mark/door #(s):  
01-08-06      02-19-02B

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	CLASSROOM LOCK	CL3555 IC6 NZD W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

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**DOOR HARDWARE**

Hardware Group No. 603W

For use on mark/door #(s):

01-08-16

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 HT 5 X 4.5	652	IVE
1	EA	PUSH/PULL LATCH	HL6 5" A (MOUNT/WITH HANDLES POINTING DOWNWARD)	626	SCH
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON- RATED DOORS)	BK	ZER

Hardware Group No. 700M

For use on mark/door #(s):

01-14-01A 01-14-02A

Provide each PR door(s) with the following:

2	EA	CONT. HINGE	224HD	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	PANIC HARDWARE	99-L-06	626	VON
1	EA	PANIC HARDWARE	99-L-DT-06	626	VON
1	EA	MORTISE CYLINDER	1077-114-A02-7 X CT6		C-R
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
2	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	626	IVE
2	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON- RATED DOORS)	BK	ZER

Hardware Group No. 701

For use on mark/door #(s):

01-07-02A 01-11-00B 02-19-07

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PANIC HARDWARE	99-L-06	626	VON
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN

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**DOOR HARDWARE**

1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. 731CR

For use on mark/door #(s):

01-14-03

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD	628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-BE-F-06	626	VON
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

Hardware Group No. 731R

For use on mark/door #(s):

01-00-10A      01-19-06A

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD	628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-BE-F-06	626	VON
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER

Hardware Group No. 800AV

For use on mark/door #(s):

01-00-00B

Provide each PR door(s) with the following:

2	EA	CONT. HINGE	224HD	628	IVE
2	EA	DUMMY PUSH BAR	330	626	VON
2	EA	90 DEG OFFSET PULL	8190HD 10" A	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	SEAL	SEAL BY DOOR/FRAME MANUFACTURER		UNK
1	EA	ASTRAGAL	MEETING STILE BY DOOR MANUFACTURER		UNK

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**2019-12-06**  
**12/6/2019**

**DOOR HARDWARE**

**087100-28**

Hardware Group No. 801L

For use on mark/door #(s):

02-17-10A	02-17-10B	02-17-11A	02-17-11B	02-17-35A	02-17-35B
02-17-40	02-17-48A	02-17-48B	02-17-49A	02-17-49B	

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD	628	IVE
1	EA	CLASSROOM DEADBOLT	DL3017 W/ CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER

Hardware Group No. C001

For use on mark/door #(s):

01-15-02B	01-15-03B	01-15-04B	01-15-05B	01-15-06B	01-15-07B
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Provide each SL door(s) with the following:

1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK
1	EA	NOTE	HARDWARE BY DOOR MANUFACTURER		ADS

Hardware Group No. C201

For use on mark/door #(s):

01-01-01B	01-01-02B	01-01-03B	01-01-04B	01-01-05	01-01-06
01-01-07	01-01-08	01-01-09	01-01-10	01-05-04	01-06-02
01-07-01	01-08-01B	01-08-11	01-08-12	01-09-07	01-10-10
01-10-11	01-11-05	01-13-07	01-15-11A	01-15-11B	01-15-14
02-05-10	02-17-01A	02-19-16	02-19-21		

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
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**DOOR HARDWARE**

1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	STOREROOM LOCK	ND80TDEU RHO RX CON12V/24V DC	626	SCH
1	EA	PERMANENT CORE	8070-A02-6 TYPE AS REQ KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK

Hardware Group No. C201C

For use on mark/door #(s):

01-01-00A

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	STOREROOM LOCK	ND80TDEU RHO RX CON12V/24V DC	626	SCH
1	EA	PERMANENT CORE	8070-A02-6 TYPE AS REQ KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK

Hardware Group No. C201W

For use on mark/door #(s):

01-04-03      01-05-03      01-07-02B      01-07-02C      01-08-02      01-08-07  
01-08-08      01-08-09      01-08-10      01-13-04      02-17-07

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 5 X 4.5	626	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON

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**Childers Architect**  
**2019-12-06**  
**12/6/2019**

**DOOR HARDWARE**

1	EA	STOREROOM LOCK	ND80TDEU RHO RX CON12V/24V DC	626	SCH
1	EA	PERMANENT CORE	8070-A02-6 TYPE AS REQ KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK

Hardware Group No. C2051

For use on mark/door #(s):

01-04-01

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	STOREROOM LOCK	ND80TDEU RHO RX CON12V/24V DC	626	SCH
1	EA	PERMANENT CORE	8070-A02-6 TYPE AS REQ KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	328AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK

Hardware Group No. C207

For use on mark/door #(s):

01-00-02A      01-09-00A

Provide each SGL door(s) with the following:

3	EA	HINGE	5BB1 4.5 X 4.5	626	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON

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**12/6/2019**

**DOOR HARDWARE**

1	EA	STOREROOM LOCK	ND80TDEU RHO RX CON12V/24V DC	626	SCH
1	EA	PERMANENT CORE	8070-A02-6 TYPE AS REQ KEYED AS DIRECTED		C-R
1	EA	OH STOP	100S ADJ	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK

Hardware Group No. C711

For use on mark/door #(s):

01-07-14	01-08-00A	01-08-00B	01-09-01A	01-09-01B	01-11-00A
01-11-00C	01-13-01	01-16-11	02-19-01A		

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L-NL-06-CON	626	VON
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON-RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	PS902 900-2RS		VON

Hardware Group No. C711C

For use on mark/door #(s):

02-17-23	02-17-36	02-17-45
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Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON

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**DOOR HARDWARE**



1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L-NL-06-CON	626	VON
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON- RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	PS902 900-2RS		VON

Hardware Group No. C711R

For use on mark/door #(s):

02-18-02          02-19-08          02-19-30

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-L-NL-F-06-CON	626	VON
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	626	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	188SBK (USE SILENCERS AT NON- RATED DOORS)	BK	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	PS902 900-2RS		VON

Hardware Group No. C714AM

For use on mark/door #(s):

01-00-00A

Provide each PR door(s) with the following:

2	EA	CONT. HINGE	224HD EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON

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**DOOR HARDWARE**

1	EA	ELEC PANIC HARDWARE	RX-QEL-99-EO-CON 24 VDC	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-OP-110MD-CON	626	VON
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
2	EA	90 DEG OFFSET PULL	8190HD 10" A	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	SEAL	SEAL BY DOOR/FRAME MANUFACTURER		UNK
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
2	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	PS902 900-2RS		VON

Hardware Group No. C715

For use on mark/door #(s):

01-00-10B	01-00-11	01-00-13	01-00-14	01-05-01C	01-13-01B
01-14-01B	01-14-02B	01-16-07B	01-19-06B	03-19-01	

Provide each SGL door(s) with the following:

1	EA	CONT. HINGE	224HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-OP-110MD-CON	626	VON
1	EA	RIM CYLINDER	3097-178-6 X CT6		C-R
1	EA	PERMANENT CORE	C6 KEYED AS DIRECTED		C-R
1	EA	90 DEG OFFSET PULL	8190HD 10" A	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	328AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	65A-223	A	ZER
1	EA	MULTITECH READER	MT15	BLK	SCE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CARD READER BY SECURITY CONTRACTOR		UNK
1	EA	POWER SUPPLY	PS902 900-2RS		VON

End of Section

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**Childers Architect**  
**2019-12-06**  
**12/6/2019**

**DOOR HARDWARE**

**087100-34**

## SECTION 08 8000

### GLAZING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Glass, glazing, and supplementary items necessary for installation; including glass specified in other Sections where glazing requirements are specified by reference to this Section.
- B. Quality Standards - Alternate: Include alternate to provide enhanced Quality Standards for glass fabrication.
  - 1. The Contract Documents require compliance with manufacturer/fabricator's enhanced quality standards. The emphasis of these quality standards is architectural glass that is manufactured and fabricated to standards requiring high-quality materials, fabrication and skillful workmanship to meet the aesthetic requirements of the Project.

##### 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 according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.
- D. Deterioration of Coated Glass: Defects developed from normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass Units: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

##### 1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.

- B. Project Glazing Analysis: Prepared by manufacturer for primary glass or fabricator for fabricated glass units. Analyze each glass type and glazing condition for thermal, wind, impact and additional design loads indicated in glass performance requirements.
  - 1. Provide glass products in the thickness and strengths required to meet or exceed the criteria based on project loads and in-service conditions.
- C. Delegated Engineering – Structural Glass and Other Applications Exceeding Project Glazing Analysis: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
- D. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- E. Coordination of Work:
  - 1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
  - 2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: Manufacturer’s technical literature for each product and system indicated.
  - 1. Include manufacturer’s specifications for materials, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Show details of each type of glazing in conjunction with the appropriate framing system; indicate type of glass, sizes, shapes, glazing material, and quantity. Include details indicating glazing thickness, bite on glass, glass edge clearance, and depth of rabbet.
- C. Samples for Verification Purposes: For each type of glass product and glazing material, in the form of 12 in (300 mm) square sample for glass (except clear) and of 12 in (300 mm) long samples for glazing materials.

- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- B. Manufacturer's Project Acceptance Documents: Certifications by the manufacturer that its products and systems are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
  - 1. Certification attesting application and use of glass for effects of thermal loading under expected service temperature ranges has been reviewed, and specified maximum probabilities of breakage will not be exceeded.
  - 2. Certifications attesting performance for specified design wind load criteria, has been reviewed; furnish design factor, statistical probability of breakage and center deflection for the largest size of each thickness and type.
  - 3. Certifications attesting face pressure of heat-strengthened glass units falls within limits specified. Glass determined to be outside these limits shall be replaced at no cost to Owner.
  - 4. Insulated Glass Units: Certification from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.
- C. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction Test Reports: For insulating or laminated glass and elastomeric glazing sealants. Provide preconstruction adhesion and compatibility test report.
- E. Source Quality Control Reports for Quality Standards - Alternate: If requested, written reports documenting testing procedures and recorded measurements.
  - 1. Distortion Tolerance Measurements: For heat-treated glass 6mm or thicker.
  - 2. Insulating Glass Unit Fabrication and Testing Requirements: For insulating glass units.
  - 3. Glass Color Measurements: For monolithic coated glass and insulating coated glass units.
- F. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- G. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

H. Warranty: Sample of Warranty.

1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

## 1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: To include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
4. Certification: Installer shall be certified under the National Glass Association's Certified Glass Installer Program.

B. Glazing Publications: Comply with published recommendations of glass product 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. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

C. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1. Acceptable Products: Complying with CSPC 16 CFR 1201, Category II.
2. Products Not Permitted: Wired Glass.

D. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

E. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

## 1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- B. Testing and Field Constructed Mock Ups: Provide glass and glazing materials for mock ups.
- C. Coated Spandrel Glass: Following coating quality criteria shall apply when viewed from indicated distance.
1. At distance of 16 ft (4.8 m) or more under natural light conditions, color and reflectance may vary slightly when viewed against a dark, uniform background. Reflectance variations of plus or minus 1.5 percent are permissible.
  2. At distance of 16 ft (4.8 m) or more under natural light conditions, pinholes and scratches, where viewed in reflectance, are considered acceptable if not obvious.

#### 1.9 **PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  3. Record discussions, including decisions and agreements, and prepare report.

#### 1.10 **DELIVERY, STORAGE, AND HANDLING**

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. Insulating Glass Units: Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### **1.11 PROJECT 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 (4.4 deg C).

#### **1.12 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

#### **1.13 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design of product. "Defects" are defined to include but not limited to deterioration or failure to perform as required.
  - 1. Coated Glass: Manufacturer's standard but not less than 10 years after date of Substantial Completion.
  - 2. Insulating Glass Units:
    - a. Deterioration of Insulating Glass Units: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
    - b. Manufacturer's standard but not less than 10 years after date of Substantial Completion.
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  - 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".



- B. Glass Type Schedules:
1. Exterior: As scheduled, or as indicated in Exterior Elevation Drawings
  2. Interior: As indicated on the drawings. Provide glazing panes 1/4 in (6 mm) thick unless noted otherwise.

## 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## 2.3 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 the following: 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. Design Loads: Glazing shall withstand design loads according to ASTM E 1300 including, but not limited to, gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable local building codes, and as indicated.
1. Structural Movement: Glazing shall withstand movements of structure including, but not limited to, drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads. Contractor shall obtain required design data and identify movements accommodated on submittal drawings.
    - a. System shall accommodate plus or minus 3/8 in (10 mm) differential vertical deflection of floors.
- C. Exterior Glazing:
1. Design Wind Pressures: As indicated on Drawings.
  2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
  3. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically 15 degrees or less from vertical and under wind action for minimum of 60 seconds duration.
  4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
  5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/100 times the short-side length or 1 in (25mm), whichever is less.
  6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
  7. Human Impact Loads: Locations indicated, and as defined by building code; glazed with safety glass.
  8. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Interior Glazing:

1. Maximum Lateral Deflection: For glass supported on all four edges or two edges, limit center-of-glass deflection to not more than 1/100 times the short-side length or 1/2 in (12 mm), whichever is less, at 10 lb/sq ft lateral load.
2. Differential Deflection: Where interior glazing is installed adjacent to a walking surface, the differential deflection of two adjacent unsupported edges shall not be greater than the thickness of the panels when a force of 50 lb/lin ft (730 N/m) is applied horizontally to one panel at any point up to 42 in (1050 mm) above the walking surface.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
4. Human Impact Loads: Locations indicated, and as defined by building code; glazed with safety glass.

## 2.4 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
  2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- B. Strength: Provide Kind HS heat-treated float glass or Kind FT heat-treated float glass, unless otherwise indicated.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. 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 1/4 in (6 mm) thick.
  2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  3. U-Factors: Center-of-glazing values, according to NFRC 100, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
  4. Solar Heat-Gain Coefficient and Visible Light Transmittance: Center-of-glazing values, according to NFRC 200.
  5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.5 GLASS PRODUCTS

- A. Primary Float Glass Manufacturers:
1. AGC Glass Co. North America, Inc.
  2. Guardian Industries Corporation
  3. Pilkington North America, Inc.
  4. PPG Industries, Inc.
  5. Citadel Architectural products
- B. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

- C. ) unless otherwise indicated; of kind and condition indicated.
1. Kind HS (heat strengthened) at exterior conditions and where recommended by manufacturer to comply with performance requirements.
  2. Kind FT (fully tempered) where indicated, where recommended by manufacturer to comply with performance requirements or required for safety glazing.
  3. Class 1 (clear) unless otherwise indicated.
  4. Class 2 (tinted), where indicated.
  5. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
  6. For uncoated glass, comply with requirements for Condition A.
  7. For coated vision glass, comply with requirements for Condition C (other coated glass).
- D. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and with other requirements as specified.

## 2.6 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. 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 (PVB) interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
  2. Interlayer Thickness: Minimum 0.030 in (0.75 mm) unless otherwise indicated.
    - a. Heat Strengthened and Fully Tempered Glazing: 0.060 in (1.5 mm) minimum.
  3. Interlayer Color: Clear unless otherwise indicated.
  4. Typical Interlayer - Manufacturers and Products:
    - a. DuPont; Butacite.
    - b. Solutia Inc.; Saflex.
    - c. Viracon

## 2.7 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal, with polyisobutylene primary seal and silicone secondary seal in accordance with ASTM C 1249. Voids or skips in the primary seal are not allowed.
  2. Spacer: Provide a hermetically sealed and dehydrated space; lites shall be separated by a spacer with three bent corners and one keyed-soldered corner or four bent corners and one straight butyl injected zinc plated steel straight key joint.
    - a. Spacer Material and Color:

- 1) Division 8 Section Glazed Aluminum Framing Systems: Aluminum with mill or clear anodic finish, unless otherwise indicated.
3. Desiccant: Molecular sieve or silica gel, or blend of both.

## 2.8 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.
- B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; 3/16 in (5 mm) nominal thickness.
  1. Manufacturers and Products:
    - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite
    - b. Saffi First, a Division of O'Keefe's Inc.; SuperLite C/SP (for ratings up to 45-minute only)
    - c. Schott North America, Inc.; Pyran Star
    - d. Vetrotech Saint-Gobain; SGG Keralite FR-R
  2. Locations: Where indicated on drawings for 20, 45, 60, and 90 minute ratings where safety glazing is not required.
- C. Laminated Ceramic Glazing: Laminated glass made from 2 plies of clear, ceramic flat glass; 5/16-inch (8-mm) total nominal thickness; complying with testing requirements in 16 CFR 1201 for Category II materials.
  1. Manufacturers and Products:
    - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite Plus
    - b. Oldcastle Glass, Inc.; Pyroguard
    - c. Schott North America, Inc.; Pyran Star L
    - d. Vetrotech Saint-Gobain; SGG Keralite FR-L
  2. Locations: Where indicated on drawings for 20, 45, 60, 90, and 120 minute ratings where safety glazing is required.
- D. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
  1. EPDM complying with ASTM C 864.
  2. Silicone complying with ASTM C 1115.
  3. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- E. Soft Compression Gaskets: Extruded or molded closed-cell, integral-skinned gaskets of EPDM, silicone, or thermoplastic polyolefin rubber, complying with ASTM C 509, Type II, black, and of profile and hardness required to maintain watertight seal and compatible with sealants.
  1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

- F. Provide factory pre-molded, vulcanized or heat welded corners, for continuous, joint-free glazing material around sides of the glazing rabbet. Field-cut corners not allowed.
- G. Provide gasket slightly longer than opening to be filled, as recommended by gasket manufacturer.

## 2.9 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
  - 1. AAMA 806.3 tape is for high-performance commercial glazing applications involving continuous pressure from gaskets or pressure-generating stop designs. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

## 2.10 ENGINEERED TRANSITION ASSEMBLIES

- A. Engineered Transition Assembly: Provide engineered transition assembly to seal air barrier perimeter to windows, doors and glazed aluminum framing systems.
  - 1. Basis of Design: Tremco, Inc; Proglaze Engineered Transition Assembly (ETA).
- B. Pre-Engineered Aluminum and Silicone Materials: Mechanically attach system assembly to glazed aluminum framing systems and provide durable seal. Engineered transitions assembly includes the following components:
  - 1. Silicone Rubber Sheet (SRS): Extruded, 40 durometer, translucent silicone, with lock-in rubber dart.
  - 2. Silicone Rubber Corners (SRC): Pre-molded, 40 durometer, translucent silicone, with lock in rubber dart
  - 3. Silicone Sealants: Comply with ASTM C 920, single-component, neutral-curing silicone; Class 100/50, Grade NS, Use O.
    - a. Basis of Design: Tremco Inc.; Spectrem 1, or other approved sealant as recommended by manufacturer.
  - 4. Extruded Aluminum Attachment (EAA): Alodine finished, pre-engineered profile designed to receive silicone lock-in rubber dart. Pre-drilled extrusion with butyl tape, 100% solid **polyisobutylene-cross linked butyl preformed sealant.**

## 2.11 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive 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.

## **2.12 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.
- B. Grind smooth and polish exposed glass edges and corners.

## **2.13 SOURCE QUALITY CONTROL - ALTERNATE**

- A. Inspections and Testing: Manufacturer/fabricator shall perform pre-construction source quality-control inspections and testing, including but not limited to the following.
  - 1. Basis of Design for Quality Standard: PPG Skyline Quality Standard or equivalent standard as recommended by glass manufacturer/fabricator and accepted by the Architect.
  - 2. Certification: Certifications by the manufacturer/fabricator that its products and systems comply with requirements and that products failing to meet requirements are not incorporated into the Work.
  - 3. Documentation: Inspection and testing records shall be maintained for a period of 10 years from the date of Substantial Completion. Provide inspection and testing records upon request and at no cost to Owner or Architect.
- B. Distortion Tolerance Measurement for Processing Heat-Treated Glass.
  - 1. On-Line Distortion Measurement System: Measure each piece of monolithic, uncoated or coated, heat-treated glass 6 mm or thicker.
    - a. Visual Mock Up Glass: Measurements for glass panels used in mock ups shall establish fabrication tolerances for the Project. Glass panels used in visual mock ups shall be fabricated to and representative of the same fabrication tolerances as glass panels used on the Project.
  - 2. Roll Wave and Millidiopter Maximum Distortion Tolerances: On-Line Measurement.
    - a. Roll Wave (Horizontal) Distortion Tolerances: Maximum 0.003 inch at center of panel; 0.008 inch at edges of panel. Measurements are from peak to valley.
    - b. Millidiopter Measurements: 90% of surface area shall be within a maximum range of plus or minus 120 millidiopeters overall.

- c. Measurement Device: On-Line measurement system utilizing high resolution optics measured in diopters.
    - d. Exclusions: Silk screen, full coverage ceramic frit glass and glass panels 10 mm and thicker are excluded from this requirement.
  - 3. Bow/Warp Distortion Tolerance (Concave/Convex): Off-Line Straight Edge Measurement.
    - a. Bow/Warp Distortion Tolerance: Limited to a maximum of 1/2 of tolerances indicated in ASTM C1048 or 1/32 in (0.8 mm) per lineal foot.
- C. Insulating Glass Unit Fabrication and Testing Requirements.
- 1. Primary Seal - Sealant Adhesion Testing: Manufacturer's recommended IGU adhesion pull testing process on units fabricated at the same time of production and on the same production line using the same processing equipment for the production of this Project. Conduct testing each shift or carton change on units not less than 24 in (600 mm) x 24 in (600 mm).
    - a. Adhesion Criteria: Comply with pass/fail requirements of manufacturer's published guidelines and/or manufacturer's certification requirements.
  - 2. Desiccant Temperature Rise Testing:
    - a. Criteria: Comply with desiccant manufacturer's written recommendations.
  - 3. Bow/Warp Unit Distortion Tolerance (Concave/Convex): Off-Line Straight Edge Measurement.
    - a. Bow/Warp Unit Distortion Tolerance: Limited to a maximum of 1/2 of tolerances indicated in ASTM C1048 or 1/32 in (0.8 mm) per lineal foot.
    - b. Air Space Gap Measurement: Visually inspect all units and measure center air space gap on all finished units over 35 square feet.
      - 1) Air Space Gap Tolerance: Maximum plus or minus 1/16 in (1.5 mm) at time of fabrication.
  - 4. Coating Edge Deletion: Clean, straight and precise.
    - a. Coating Edge Deletion Tolerance: Uniformly remove coating to the greater of 3/8 in (10 mm) from the glass edge or between centerline of the spacer and top of primary seal.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

- B. 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.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- C. 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.

### **3.4 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- 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 in (1270 mm).
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8 in (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- 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 according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. 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.
- L. One-Way Observation Mirrored Glazing: Install with reflective surface facing the brightly lit subject-side.

### **3.5 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. 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.

### 3.6 GASKET GLAZING (DRY)

- A. Fabricate 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 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 by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may employ and pay for qualified independent testing agency to perform field quality control test in accordance with Division 01 Section "Field Test for Water Leakage". Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.

### 3.8 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. 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; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project 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.

**3.9 GLASS TYPE SCHEDULE:** Refer to Exterior Elevation Drawings.

**END OF SECTION**



## SECTION 08 8300

### UNFRAMED MIRRORED GLAZING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required for this section includes the following types of unframed mirrored glass, typically indicated as mirror Type "S", and supplementary items necessary to complete their installation.
- B. Related Section:
  - 1. Metal framed mirror units are specified in Division 10 Section "Toilet Accessories."

##### 1.2 DEFINITIONS

- A. Deterioration of Silvered Mirrored Glass: Defects developed from normal use that are attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning silvered mirrored glass contrary to mirrored glass manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

##### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 2. Include product data for mirror mastic and mirror hardware.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
- C. Samples: For the following products, in sizes indicated below:
  - 1. Mirrors: 12 in (300 mm) square, including edge treatment on two adjoining edges.
  - 2. Mirror Clips: Full size.
  - 3. Mirror Trim: 12 in (300 mm) long.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- B. Mirror Mastic Glass Coating Compatibility Test Reports: From an organic protective coating manufacturer indicating that mirror mastic has been tested for compatibility and adhesion with organic protective coating applied to silvered mirrored glass. Include organic coating manufacturers' interpretation of test results relative to performance and recommendations for use of mastics with organic protective coating.
- C. Qualification Data:

1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

## **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in mirrored glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- B. Glazing Publications: Comply with published recommendations in GANA's "Glazing Manual," unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
- C. NAAMM's Publication: For silvered mirrored glass, comply with recommendations in NAAMM's "Mirrors, Handle with Extreme Care, Tips for the Professional on the Care and Handling of Mirrors."
- D. Safety Glass: For film-backed, laminated or tempered mirrors provide Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- E. Preconstruction Mirror Mastic Glass Coating Compatibility Test: Submit mirror mastic products to organic protective coating manufacturer for testing to determine compatibility of adhesive with mirrored glass coating.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect glazing materials according to mirrored glass manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirrored glass manufacturer's written instructions for shipping, storing, and handling mirrored glass as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

## **1.7 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install mirrored glass until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

## **1.8 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **1.9 WARRANTY**

- A. Manufacturer's Special Warranty: Written warranty made out to Owner and signed by mirrored glass manufacturer agreeing to replace silvered mirrored glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site.

1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.2 SILVERED FLAT GLASS MIRRORS**

- A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Clear Glass: Mirror Select Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
  - 1. Nominal Thickness: 1/4 in (6 mm).
- C. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
  - 1. Nominal Thickness: 1/4 in (6 mm).
- D. Laminated Mirrors: ASTM C 1172, Type II.
  - 1. Glass for Outer Lite: Annealed float glass, Mirror Select Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
    - a. Nominal Thickness for Outer Lite: 1/8 in (3 mm).
  - 2. Glass for Inner Lite: Annealed float glass; ASTM C 1036, Type I (transparent flat glass), Quality-Q3; Class 1 (clear).
    - a. Nominal Thickness: 1/8 in (3 mm).
  - 3. Interlayer: Mirror manufacturer's standard 0.030 in (0.75 mm) thick, clear polyvinyl-butylal interlayer with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.

### **2.3 MISCELLANEOUS MATERIALS**

- A. Setting Blocks: Neoprene, 70 to 90 Shore A hardness.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirrored glass manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, produced specifically for setting mirrored glass by spot application, certified by both mirrored glass manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrored glass will be installed.
  - 1. VOC Content: Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Top and Bottom Trim: Stainless steel J-channels formed with a return deep enough to produce a glazing channel to accommodate mirrored glass units of thickness indicated and in lengths required to cover bottom edge of each mirrored glass unit in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 in (10 and 21 mm) in height, respectively, and a thickness of not less than 0.05 in (1.25 mm).
  2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 in (15 and 25 mm) in height, respectively, and a thickness of not less than 0.062 in (1.6 mm).
  3. Fastener Holes: Minimum 6 in (150 mm) on center with countersunk face for flush screw application, slotted holes for top trim.
  4. Finish: No. 4 satin finish, Type 304 stainless steel.
- E. Fasteners: Stainless steel flat head machine screws. 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. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

## 2.4 FABRICATION

- A. Silvered Mirrored Glass: Float glass with successive layers of chemically deposited silver, electrically or chemically deposited copper, and manufacturer's standard organic protective coating applied to second glass surface to produce a coating system complying with FS DD-M-411.
- B. Mirrored Glass Sizes: Cut mirrored glass to final sizes and shapes to suit Project conditions.
- C. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.
- D. Mirrored Glass Edge Treatment: Treat edges as indicated below:
1. Seamed (swiped) edge when butted against wall, flat polished edge when edge is exposed.
  2. Seal edges of silvered mirrored glass after edge treatment to prevent chemical or atmospheric penetration of glass coating.
  3. Require mirrored glass manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- E. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.



## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
  - 4. Referenced GANA and NAAMM publications.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION**

- A. General: Mount mirrored glass accurately in place in a manner that avoids distorting reflected images.
- B. Provide space for air circulation between back of mirrored glass units and face of mounting surface.
- C. Install permanent means of support at bottom and top edges with bottom support designed to withstand mirrored glass weight and top support designed to prevent mirrored glass from coming away from wall along top edges.
  - 1. Unless otherwise indicated, install continuous bottom and top trim. Fabricate trim in single lengths to fit and cover top and bottom edges of mirrored glass units.
  - 2. Attach mirror hardware securely to steel back up plates with mechanical fasteners and anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrored glass units.
  - 3. For continuous bottom supports, provide setting blocks 1/8 in (3 mm) thick by 4 in (100 mm) long at quarter points. For channel supports in which water could be trapped between setting blocks, provide two slotted weeps not less than 1/4 in (6 mm) wide by 3/8 in (10 mm) long.
  - 4. Place a felt or plastic pad between back of mirrored glass and each fastener to prevent spalling of mirrored glass edges or damaging mirror backing.

5. Exercise extreme caution to avoid scratching silvering on mirror back during installation. Mirrors which are scratched, cracked, chipped or in any manner damaged shall be removed and replaced with new, undamaged mirrors.
- D. Mastic Spot Installation System: In addition to top and bottom trim supports, install mirrored glass units with mastic as follows:
1. Apply barrier coat to mirrored glass backing where approved in writing by manufacturers of mirrored glass and backing material.
  2. Apply mastic in spots to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrored glass units and face of mounting surface.
  3. After mastic is applied, align mirrored glass units and press into place while maintaining a minimum air space of 1/8 in (3 mm) between back of mirrored glass and mounting surface.

### **3.5 PROTECTION AND CLEANING**

- A. Protect mirrored glass from breakage and contaminating substances resulting from construction operations.
1. Do not permit edges of silvered mirrored glass to be exposed to standing water.
  2. Maintain environmental conditions that will prevent silvered mirrored glass from being exposed to moisture from condensation or other sources for continuous periods of time.
- B. Wash mirrored glass before date scheduled for inspections intended to establish date for Substantial Completion. Wash mirrored glass by methods recommended in NAAMM publication and in writing by mirrored glass manufacturer. Use water and glass cleaners free from substances capable of damaging mirrored glass edges or coatings.

**END OF SECTION**

## SECTION 09 2900

### GYPSUM BOARD ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Metal framing systems, interior gypsum board faced walls, partitions, and ceiling assemblies, and supplementary items necessary for installation.

##### 1.2 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 for definitions of terms not defined in this Section or in other referenced quality standards.
- B. Damage: Stored or installed gypsum board materials shall be classified as defective and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew.
- C. Concentrated Loads: Wall or partition mounted equipment, wall finishes, stone facings, lead lined doors and frames, or ornamentation exceeding 15 lbs/sf uniform load, 75 lb. point load, or 50 lb/ lf lineal load.

##### 1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.
- B. Project Framing Analysis: Analyze each framing condition for design loads indicated in performance requirements.
  - 1. Provide framing products in sizes and thicknesses required to meet or exceed the criteria based on project loads, spans and in-service conditions.
  - 2. Material Quality Standard for Metal Framing Components: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.
- C. Gypsum Board Assemblies Supporting Concentrated Loads - Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems required to support concentrated loads including attachment to building structure required to meet design intent of Contract Documents including, but not limited to, the following.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.

- D. Gypsum Board Assemblies Withstanding Seismic Loads - Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems required to withstand seismic loads including attachment to building structure required to meet design intent of Contract Documents including, but not limited to, the following.
1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- F. Coordination of Contract Documents and Work:
1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturer/fabricators. Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
  2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Include scaled and dimensioned drawings showing locations of control joints. Distinguish between shop and field-assembled work.
1. Gypsum Board Location Schedule: Provide detailed schedule in format similar to "Gypsum Board Schedule" at end of this Section indicating gypsum board products to be installed and their respective locations.

- C. Shop Drawings for Engineered Gypsum Board Assemblies - Concentrated Loads: Scaled and dimensioned drawings showing locations, fabrication, and installation of gypsum board assemblies required to support concentrated loads, including plans, elevations, sections, details of components, and attachments to building structure; include seal and signature of delegated engineering professional responsible for their preparation.
- D. Shop Drawings for Engineered Gypsum Board Assemblies - Seismic Loads: Scaled and dimensioned drawings showing locations, fabrication, and installation of gypsum board assemblies required to withstand seismic loads, including plans, elevations, sections, details of components, and attachments to building structure; include seal and signature of delegated engineering professional responsible for their preparation.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Preconstruction Test Reports for Acoustical Sealant: Compatibility test reports from sealant manufacturer indicating that materials forming joint substrates and joint-sealant backings have been tested for compatibility with sealants; include sealant manufacturer's certification of test results for sealant compatibility and recommendations for primers and substrate preparation needed to obtain adhesion and prevent corrosion of substrate.
- D. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- E. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- F. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects.

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.

- a. Show typical components, attachments to building structure, and requirements of installation.
  - b. Field Samples for Gypsum Board Finishing: Build 10 ft (3 m) square gypsum board (attached to metal studs) area for each finish level specified. Include not less than one tapered-to-tapered edge gypsum board joint and cut edge-to-cut edge gypsum board joint.
2. Clean exposed faces of mock-up.
  3. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  4. Demonstrate the proposed range of aesthetic effects and workmanship.
  5. Protect accepted mock-up from the elements with weather-resistant membrane.
  6. Obtain Architect's acceptance of mockups before starting fabrication.
  7. Maintain mock-ups during construction in an undisturbed condition as a standard for review of the completed Work.
  8. Acceptance of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
  9. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.
- C. Fire Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested according to ASTM E 119/NFPA 251/UL 263 by one of following independent testing and inspecting agency as evidenced by design designation included in their associated approval manual:
1. UL - "Fire Resistance Directory", Category BXUV.
  2. GA 600 - "Fire Resistance Design Manual".
  3. Other agency acceptable to authorities having jurisdiction.
- D. Smoke Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested according to indicated fire resistance rated assemblies by independent testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Sound (STC) Resistance Rated Assembly Characteristics: Provide materials and construction identical to those tested according to ASTM E 90 and classified according to ASTM E 413 by independent and testing agency acceptable to authorities having jurisdiction.

## 1.7 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## 1.8 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.

## 1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Comply with ASTM C 840 requirements or respective gypsum board manufacturer's written recommendations, whichever are more stringent.

- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **1.10 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. General Performance: Provide products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Design Loads: Provide products and systems to withstand design loads including but not limited to gravity, wind, seismic, and erection design loads established by authorities having jurisdiction, applicable local building codes, and as indicated.
  - 1. Structural Movement: Provide products and systems to withstand movements of structure including, but not limited to, drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads. Contractor shall obtain required design data and identify movements accommodated on submittal drawings.
    - a. Accommodate plus or minus 3/8 in (10 mm) differential vertical deflection of floors.
- C. Dimensional Tolerances: Provide products and systems to accommodate dimensional tolerances of framing members and adjacent construction.

### **2.4 SUSPENDED GRID SYSTEM FOR INTERIOR CEILINGS**

- A. Suspension System:
  - 1. Material Quality Standard: ASTM C 645, heavy-duty rating.

2. Description: Manufacturer's standard direct-hung suspended grid system composed of main beams and cross furring members that interlock to form a modular supporting network for application of gypsum board.
3. Protective Coating - Standard Applications: ASTM A 653/A 653M, not less than G40 (Z120), hot-dip galvanized coating, unless otherwise indicated.
4. Main Beams: Inverted T-shaped profile of single or double mounting flange; minimum 1-1/2 in (38 mm) profile height with top bulb and minimum 1-3/8 in (35 mm) wide knurled mounting flange; factory punched for hanger wire, and to receive cross furring members.
5. Cross Furring Members:
  - a. Tees: Inverted T-shaped profile of single or double mounting flange; 1-1/2 in (38 mm) profile height with top bulb and minimum 1-3/8 in (35 mm) wide knurled mounting flange; with ends formed for positive interlocking with main beam.
  - b. Channels: Inverted hat shaped profile; minimum 7/8 in (21 mm) profile height and minimum 1-3/8 in (35 mm) wide knurled mounting flange; with ends formed for positive interlocking with main beam.
6. Wall Angle: Angle shaped profile with each leg not less than 1-1/4 in (32 mm).
7. Curved Members: Where curved ceilings are indicated, members shall be rolled by manufacturer; field fabricated curved members not permitted.
8. Accessories: Specifically designed as an integral part of suspended grid system.
9. Manufacturers and Products:
  - a. Armstrong World Industries Inc.; Drywall Grid System.
  - b. Chicago Metallic Corporation; 650-C/670-C Fire-Rated Drywall Grid System.
  - c. United States Gypsum Company (USG Interiors, Inc.); Drywall Suspension System.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
  - a. Cast-in-place anchor, designed for attachment to concrete.
  - b. Post-installed chemical anchor.
  - c. Post-installed expansion anchor.
2. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A 10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
3. Manufacturers:
  - a. Construction Materials, Inc.
  - b. Heckman Building Products, Inc.
  - c. Hilti Corp.
  - d. ITW Ramset/Red Head.
  - e. Powers Fasteners.
  - f. Simpson Strong Tie Anchor Systems.



4. For post-tensioned concrete, anchors shall not exceed 1 in (25 mm) embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.

C. Wire:

1. Material Quality Standard: ASTM A 641 / A 641M, Class 1, zinc-coated, soft annealed, mild steel wire.
2. Tie Wire Minimum Size: Single 0.0625 in (16 gage) (1.6 mm) diameter strand, or double 0.0475 in (18 gage) (1.2 mm) diameter strands. Preformed furring channel clips are acceptable.
3. Hanger Wire Minimum Size: 0.1620 in (8 gage) (4.12 mm) diameter.

D. Rod Hangers: ASTM A 1008 / A 1008M, 7/32 in (0.56 mm) diameter mild carbon steel rod, with primer painted finish.

E. Flat Hangers: ASTM A 1008 / A 1008M, 1 in by 3/16 in (25 mm by 5 mm) by length indicated or required, with primer painted finish.

F. Angle Hangers: ASTM A 36 / A 36M, rolled steel angle, 2 in by 2 in (50 mm by 50 mm), with primer painted finish.

## 2.5 METAL FRAMING COMPONENTS

A. Project Framing Analysis: Analyze each framing condition for design loads indicated in performance requirements.

1. Provide framing products in sizes and thicknesses required to meet or exceed the criteria based on project loads, spans and in-service conditions.

B. Material Quality Standard: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.

1. Sheet Steel: ASTM C 645 for metal.
2. Protective Coating - Standard Applications: ASTM A 653/A 653M, not less than G40 (Z120), hot-dip galvanized coating, unless otherwise indicated.
3. Protective Coating - High Moisture / Humidity Applications: ASTM A 653 / A 653M, G90 (Z275) hot-dip galvanized coating at high moisture areas such as Kitchens, Saunas, Steam Rooms, and Pool Enclosures.

C. Metal Studs and Floor Track (Runners):

1. Standard Metal Framing Components for Typical Partitions:
  - a. Stud Description: C-shaped members formed from galvanized sheet steel with 1 1/4 in (32 mm) flange edges bent back 90 degrees and doubled over to form 13/64 in (5 mm) wide minimum return lip; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section; with web punchouts.

- 1) Alternative Jamb Stud Members - Contractor's Option: "Heavy Duty" or "King" studs; C-shaped members formed from galvanized sheet steel with 3 in (75 mm) flange width; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section.
  - b. Track (Runner) Description: U-shaped members formed from galvanized sheet steel with depth compatible with studs and flange dimension indicated to hold studs by friction; of same web size and uncoated base metal thickness as studs.
    - 1) Floor Track (Runner): 1-1/4in (32 mm).
    - 2) Top of Wall Track (Runner): 3 in (75 mm).
2. Metal Framing for Shaftwall Partitions:
- a. Stud Description: C-H, double E, C-T, or I-shaped members formed from galvanized sheet steel; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section; with web punchouts.
  - b. Track (Runner) and Jamb Description: J-shaped track or jamb members formed from galvanized sheet steel with depth compatible with studs and flange dimension indicated to hold studs by friction; of same web size and uncoated base metal thickness as studs.
3. Optional Equivalent Products - Deformed Metal Studs and Tracks (Runners):
- a. Evaluation Criteria: Product test reports and certifications from independent testing agency indicating products comply with requirements and are acceptable to authorities having jurisdiction.
  - b. Material Quality Standard: ASTM A 1003 / A 1003M sheet steel with galvanized coating.
  - c. Stud Description: C-shaped members formed from deformed surface galvanized sheet steel with 1-1/4 in (32 mm) flange edges bent back 90 degrees and bent again to form 3/16 in (5 mm) wide minimum return lip; of web depth indicated on Drawings and uncoated base metal thickness indicated in "Metal Framing Schedule" at end of this Section; with web punchouts.
  - d. Track (Runner) Description: U-shaped members formed from deformed surface galvanized sheet steel with depth compatible with studs and flange dimension indicated to hold studs by friction; of same web size and uncoated base metal thickness as studs.
  - e. Manufacturer and Product: ClarkDietrich Building Systems; ProSTUD.
- D. Flat Straps and Back-Up Plates: Galvanized sheet steel for blocking and bracing in length and width indicated, of same uncoated base metal thickness as adjacent metal studs.
- E. Bridging:
1. Channel: U-shaped members formed from galvanized sheet steel not less than 0.0566 in (16 gage) (1.44 mm) minimum uncoated base metal thickness, with 1/2 in (12 mm) flanges and depth fitting stud punchouts.
  2. Clip Angle: 1-1/2 in by 1-1/2 in (38 mm by 38 mm) L-shaped members formed from galvanized sheet steel not less than 0.0713 in (14 gage) (1.81 mm) uncoated base metal thickness.

- F. Rigid Furring Channels: Hat-shaped members formed from galvanized sheet steel not less than 0.0312 in (20 gage) (0.78 mm) minimum uncoated base metal thickness; 7/8 in (21 mm) depth and minimum 1-3/8 in (35 mm) wide knurled mounting flange.
- G. Resilient Furring Channels: 1/2 in (12 mm) deep members formed from galvanized sheet steel not less than 0.0283 in (22 gage) (0.72 mm) minimum bare-metal thickness, designed to reduce sound transmission.
  - 1. Configuration: Asymmetrical or hat shaped.
- H. Framing Accessories for Spanning Multiple Floors: Framing manufacturers standard connectors, bracings, brackets, clips, gussets, and other framing devices as required by conditions, formed from galvanized sheet steel complying with requirements of main support system.
- I. Z-Shaped Furring: Members formed from galvanized sheet steel not less than 0.0283 in (22 gage) (0.72 mm) minimum bare-metal thickness, with slotted or non-slotted web, face flange of 1-1/4 in (32 mm), wall attachment flange of 7/8 in (21 mm); depth required to fit insulation thickness indicated.
- J. Manufacturers:
  - 1. Building Products Division of Consolidated Fabricators Corp.
  - 2. California Expanded Metal Products Co. (CEMCO).
  - 3. ClarkDietrich Building Systems
  - 4. Marino Ware; Division of Ware Industries.
  - 5. MBA Metal Framing.
  - 6. Scafcop Corp.
- K. Heavy-Duty Framing Systems (HDS) Headers and Jambs at Lead Lined Doors: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Building Systems; Heavy Duty Studs - HDS and Header Bracket — HDSC and accessories as required for a complete installation.
    - a. Minimum Base-Steel Thickness: 0.0538 inch (1.37 mm) or as indicated on drawings.
    - b. Web and Flange Widths, Type HDS: 3-5/8 by 3 by 1-1/16 by 3/4 inch (92.1 by 76.2 by 27.0 by 19.1 mm) or 6 by 3 by 2-1/4 by 3/4 inch (152 by 76.2 by 57.2 by 19.1 mm); as indicated on drawings.
    - c. Web and Flange Widths, Type HDSC: 3-1/2 by 3-1/16 by 2 inches (88.9 by 77.8 by 50.8 mm) or 5-7/8 by 3-1/16 by 2 inches (149 by 77.8 by 50.8 mm); as indicated on drawings.
  - 2. Slip-Type Head Joints: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to runners while allowing for vertical movement.
    - a. Basis of Design: ClarkDietrich Building Systems; Fast Top Clip FTC3 or FTC5.

3. Anchor Clips: Pre-punched, galvanized anchor clips designed for use in floor n conditions that provide a positive attachment of studs to runners while allowing for horizontal, torsional and vertical (uplift) loads.
  - a. Basis of Design: ClarkDietrich Building Systems; EasyClip T-Series, T685 or T683.

## **2.6 PRE-ENGINEERED METAL FRAMING COMPONENTS**

### **A. Deflection and Firestop Track (Runner):**

1. Description: Proprietary track (runner) formed from galvanized sheet steel manufactured to accommodate movement of building structure without transferring stress to partition (to prevent cracking of gypsum board resulting from deflection of building structure above) 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.
2. Manufacturers:
  - a. Metal Stud Framing Manufacturer.
  - b. Fire Trak Corp.
  - c. The Steel Network.

### **B. Flexible Track (Runner):**

1. Description: Proprietary track (runner) formed from galvanized sheet steel manufactured to be flexible and adjustable to fit design requirements; in thickness not less than indicated for studs and in width to accommodate depth of studs.
2. Manufacturers:
  - a. Metal Stud Framing Manufacturer.
  - b. Accu-Arc Curved Wall Products.
  - c. Flex-Ability Concepts.
  - d. Radius Track Corp.

### **C. Headers:**

1. Description: Proprietary header assembly formed from galvanized sheet steel manufactured to bear partition load above openings without transferring stress to partition (to prevent cracking of gypsum board); in thickness not less than indicated for studs and in width to accommodate depth of studs.
2. Manufacturers:
  - a. Metal Stud Framing Manufacturer.
  - b. Brady Construction Innovations, Inc.

## **2.7 GYPSUM BOARD PRODUCTS**

- A. Sizes: Maximum lengths and widths available that will minimize short edge-to-short edge butt joints and to correspond to support system indicated.
- B. Typical Paper-Faced Gypsum Board Products:
  1. Paper-Faced Type X Gypsum Board:

- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
  - b. Description: Noncombustible fire resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick.
  - c. Manufacturers and Products:
    - 1) American Gypsum Company; FireBloc Type X Gypsum Board.
    - 2) CertainTeed Corporation; Type X Gypsum Board.
    - 3) Georgia-Pacific Gypsum LLC; ToughRock Fireguard Gypsum Board.
    - 4) National Gypsum Company; Gold Bond Fire-Shield Gypsum board.
    - 5) United States Gypsum Company (USG); Sheetrock Firecode Core.
2. Sustainable Paper-Faced Type X Gypsum Board: At Contractor's option, provide sustainable paper-faced Type X gypsum board or typical paper-faced Type X gypsum board.
- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
  - b. Description: Noncombustible fire resistant gypsum core with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick. UL Type Designation "ULIX".
    - 1) ISO 14040 Environmental Management, Life Cycle Assessment, Principles and Framework:
      - a) Carbon emissions per Gypsum Association; Industry Standard Type III EPD for North American Type X wallboard with a manufacturing Global Warming Potential of 317.4 kg CO<sub>2</sub>-eq./1000MSF.
      - b) Water reduction per Gypsum Association; Industry Standard Type III EPD for North American Type X wallboard having net use of fresh water value of 1.329 m<sup>3</sup>/1000 ft<sup>2</sup>.
      - c) Primary Energy from non-renewable resources per Gypsum Association; Industry Standard Type III EPD for North American Type X wallboard have a value of 5,291 MJ/1000 ft<sup>2</sup>.
  - c. Basis of Design:
    - 1) United States Gypsum Company, LLC, USG Sheetrock Brand EcoSmart Panels Firecode X.
3. Paper-Faced Type C Gypsum Board:
- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
  - b. Description: Noncombustible fire resistant gypsum core, with additives to enhance fire resistance, with paper surfacing on face, back, and long edges; tapered long edges; 5/8 in (15 mm) thick.
  - c. Manufacturers and Products:
    - 1) American Gypsum Company; FireBloc Type C Gypsum Board.
    - 2) CertainTeed Corporation; Type C Gypsum Board.
    - 3) Georgia-Pacific Gypsum LLC; ToughRock Fireguard C Gypsum Board.
    - 4) National Gypsum Company; Gold Bond Fire-Shield C Gypsum board.
    - 5) United States Gypsum Company (USG); Sheetrock Firecode C Core Gypsum Panels.

4. Paper-Faced Flexible Gypsum Board at Curved Surfaces:

- a. Material Quality Standard: ASTM C 1396 / C 1396M.
- b. Description: Gypsum core with paper surfacing on face, back and long edges; manufactured to bend to fit tight radii and be more flexible than typical panels without wetting; tapered long edges; 1/4 in (6 mm) thick.
- c. Manufacturers and Products:
  - 1) American Gypsum Company; 1/4 ClasicRoc Gypsum Board.
  - 2) CertainTeed Corporation; 1/4 Flex Gypsum Board.
  - 3) Georgia-Pacific Gypsum LLC; ToughRock FlexRoc Gypsum Board.
  - 4) National Gypsum Company; Gold Bond High Flex Brand Gypsum board.
  - 5) United States Gypsum Company (USG); Sheetrock 1/4 Flexible Gypsum Panels.

C. Moisture-Resistant Gypsum Board Products:

1. Moisture-Resistant Paper-Faced Gypsum Board:

- a. Material Quality Standard: ASTM C 1396 / C 1396M, Type X.
- b. Description: Enhanced moisture-resistant, noncombustible gypsum core, with moisture-resistant paper surfacing on face, back and long edges; tapered long edges; score of 10 according to ASTM D 3273; 5/8 in (15 mm) thick.
- c. Manufacturers and Products:
  - 1) American Gypsum Company; M-Bloc Mold and Moisture Resistant Type X Gypsum Board.
  - 2) CertainTeed Corporation; M2Tech Moisture and Mold Resistant Type X Gypsum Board.
  - 3) National Gypsum Company; Gold Bond XP Gypsum Board.
  - 4) United States Gypsum Company (USG); Sheetrock Mold Tough Firecode Gypsum Board.

2. Moisture-Resistant Paperless Glass-Mat Gypsum Board:

- a. Material Quality Standard: ASTM C 1658 / C 1658M.
- b. Description: Enhanced moisture-resistant, noncombustible gypsum core with inorganic, embedded fiberglass mat on both faces; square edges; score or 10 according to ASTM D 3273; 5/8 in (15 mm) thick.
- c. Manufacturers and Products:
  - 1) Georgia-Pacific Gypsum LLC; DensArmor Plus Fireguard Interior Guard.
  - 2) National Gypsum Company; eXP Interior Extreme Gypsum Panels.

3. Moisture-Resistant Paper-Faced Shaft-Liner Gypsum Board:

- a. Material Quality Standard: ASTM C 1396/C 1396M, Type X.
- b. Description: Enhanced moisture-resistant, noncombustible gypsum core with moisture-resistant paper surfacing on face, back and long edges; tapered long edges; score of 10 according to ASTM D 3273; 1 in (25 mm) thick.
- c. Manufacturers and Products:
  - 1) American Gypsum Company; M-Bloc Shaft Liner Panels.

- 2) CertainTeed Corporation; M2Tech Moisture & Mold Resistant Shaftliner.
  - 3) National Gypsum Company; Gold Bond 1" Fire-Shield Shaftliner XP.
  - 4) USG Corp.; SHEETROCK Mold Tough Gypsum Liner Panels.
4. Moisture-Resistant Paperless Glass-Mat Shaft-Liner Gypsum Board:
- a. Material Quality Standard: ASTM C 1396 / C 1396M.
  - b. Description: Enhanced moisture-resistant, noncombustible gypsum core with inorganic, embedded fiberglass mat on both faces, double bevel long edges; score of 10 according to ASTM D 3273; 1 in (25 mm) thick.
  - c. Manufacturers and Products:
    - 1) American Gypsum Company; M-Glass Shaft Liner Panels.
    - 2) CertainTeed Corporation; GlasRoc Shaftliner Type X.
    - 3) Georgia-Pacific Gypsum LLC; DensGlass Shaftliner.
    - 4) National Gypsum Company; eXP Extended Exposure Shaftliner.
    - 5) USG Corp.; SHEETROCK Glass-Mat Liner Panels
5. Moisture-Resistant Coated Glass-Mat Gypsum Board Products:
- a. Material Quality Standard: ASTM C 1178 / C 1178M.
  - b. Description: Enhanced moisture-resistant, noncombustible, gypsum core with inorganic, embedded fiberglass mat on both sides; outside face coated with heat-cured copolymer water-resistant coating; square edges; score of 10 according to ASTM D 3273; 5/8 in (15 mm) thick.
  - c. Manufacturers and Products:
    - 1) CertainTeed Corporation; Diamondback Tile Backer.
    - 2) Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
    - 3) National Gypsum Company; eXP Tile Backer.
6. Moisture-Resistant, Abuse-Resistant Gypsum Board Products:
- a. Material Quality Standard: ASTM C 1629 (C 1629M), Type X, and as follows:
    - 1) Soft Body Impact Test: ASTM E 695, Classification Level 2.
    - 2) Hard Body Impact Test: Annex A1, Classification Level 1.
    - 3) Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
  - b. Paper-Faced Products: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
    - 1) Manufacturers and Products:
      - a) CertainTeed Corporation; Air Renew Extreme Abuse.
      - b) National Gypsum Company; Gold Bond Hi-Abuse XP Gypsum Board.

- c. Paperless Products: Specially formulated, noncombustible, gypsum core with coated, fiberglass mat on both faces; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
    - 1) Manufacturers and Products:
      - a) National Gypsum Company; Gold Bond eXP Interior Extreme AR Gypsum Panel.
      - b) USG Corporation; Fiberock Interior Panel, Abuse Resistant.
7. Moisture-Resistant, Impact-Resistant Gypsum Board Products:
- a. Material Quality Standard: ASTM C 1629 (C 1629M), Type X, and as follows:
    - 1) Soft Body Impact Test: ASTM E 695, Classification Level 3.
    - 2) Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
  - b. Paper-Faced Products: Specially formulated, noncombustible, gypsum core with heavy liner paper on back and smooth, heavy abrasive-resistant face paper on face and long edges; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
    - 1) Manufacturers and Products:
      - a) CertainTeed Corporation; Air Renew Extreme Impact.
      - b) National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
  - c. Paperless Products: Specially formulated, noncombustible, gypsum core with coated, fiberglass mat on both faces; manufactured to produce greater resistance to surface indentation and through-penetration than typical gypsum panels; tapered long edges; 5/8 in (15 mm) thick.
    - 1) Manufacturers and Products:
      - a) Georgia-Pacific Gypsum LLC; Dens Armor Plus Impact-Resistant Interior Panels.
      - b) National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel.
      - c) USG Corporation; Fiberock Panels, VHI Abuse-Resistant.

## 2.8 TRIM ACCESSORIES

### A. Typical Drywall Trim Accessories:

- 1. Material Quality Standard: ASTM C 1047.
- 2. Description: Trim profile fabricated of galvanized steel sheet; of size suitable for gypsum board thickness; with recessed, perforated flange formed to receive joint compound.
- 3. Trim Products:
  - a. Cornerbead:



- 1) Purpose: For protecting outside (external) corners.
  - 2) Basis of Design: United States Gypsum Company (USG); Dur-A-Bead Corner Bead, 103.
- b. Optional Equivalent Products – Structural Laminate Cornerbead System: At Contractor’s option, provide high strength tapered co-polymer core cornerbead with tight fibered paperboard facing and joint tape paper backing.
- 1) Purpose: For protecting outside (external) corners.
  - 2) Basis of Design: Structus Building Technologies; No-Coat Structural Laminate Drywall Corner System.
- c. LC-Bead (J-Bead):
- 1) Purpose: For protecting exposed edges of gypsum board where back flange can be used.
  - 2) Basis of Design: United States Gypsum Company (USG); J-Trim, 200-A.
- d. L-Bead:
- 1) Purpose: For protecting exposed edges of gypsum board where back flange cannot be used.
  - 2) Basis of Design: United States Gypsum Company (USG); L-Trim, 200-B.
- e. J-Stop:
- 1) Purpose: For protecting edges of gypsum board that does not require finishing.
  - 2) Basis of Design: United States Gypsum Company (USG); J-Stop, 402.
- f. Control Joint:
- 1) Description: One-piece trim formed with V-shaped slot, with removable strip covering slot opening.
  - 2) Purpose: For conditions requiring expansion and contraction stresses of large areas of gypsum board to be relieved.
  - 3) Basis of Design: United States Gypsum Company (USG); Control Joint, 093.
- g. Other Trim or Special Shapes: Products as required by condition.
4. Manufacturers:
- a. Dietrich Industries, Inc.; Unimast.
  - b. Fry Reglet Architectural Metals.
  - c. Marino Ware; Division of Ware Industries.
  - d. Niles Building Products Co.
  - e. Superior Metal Trim; Division of Delta Star, Inc.
  - f. United States Gypsum Company (USG).

B. Plastic Drywall Trim Accessories:

1. Description: Trim profile fabricated of high-impact PVC, of size suitable for gypsum board thickness; with recessed, perforated flange formed to receive joint compound.
2. Trim Products Profiles: As listed above in "Typical Drywall Trim Accessories".
3. Manufacturers:
  - a. Alabama Metal Industries Corporation; a Gibraltar Industries Company.
  - b. Phillips Manufacturing Co.
  - c. Plastic Components, Inc.
  - d. Trim Tex Drywall Products.
  - e. Vinyl Corp., a division of ClarkDietrich Building Systems.

C. Accent Trim Accessories:

1. Description: Extruded aluminum accessories of profiles and dimensions indicated of alloy and temper with not less than strength and durability properties of ASTM B 221, alloy 6063-T5.
2. Basis of Design:
  - a. Aluminum Trim Accessory Type:
    - 1) Manufacturer: Fry Reglet
    - 2) Product: F Reveal Molding
    - 3) Reveal Dimension: 3/4-inch.
    - 4) Finish:
3. Manufacturers:
  - a. Fry Reglet Architectural Metals.
  - b. Gordon, Inc.
  - c. Pittcon Industries.

D. Wall to Aluminum Window Trim Accessories (Perpendicular to Exterior Windows):

1. Sound Barrier Partition/Mullion Trim Cap:
  - a. Description: Pre-assembled, spring loaded, extruded aluminum partition closures fabricated from 6063-T5 temper, tensile strength 31 KSI (ASTM B 221, ASTM B 221 M). STC rated with optional mineral wool batts for additional sound attenuation (approx. STC 57). Seal to mullion and wall or glass and wall with foam gasket, adhesive both sides.
  - b. Manufacturers and Products:
    - 1) Basis of Design: "Mull-it-Over", 57 Wide Sound Barrier Mullion Trim Cap.
    - 2) STC: 57.
    - 3) Finish: As selected by Architect to match mullion finish.

## 2.9 FASTENERS

- A. Limitations: Nails and staples are not permitted.
- B. Fasteners for Attaching Metal Framing to Concrete Structure:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
    - a. Cast-in-place anchor, designed for attachment to concrete.
    - b. Post-installed chemical anchor.
    - c. Post-installed expansion anchor.
  2. Powder-Actuated Fasteners: Suitable for application indicated, ANSI A 10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
  3. Manufacturers:
    - a. Construction Materials, Inc.
    - b. Heckman Building Products, Inc.
    - c. Hilti Corp.
    - d. ITW Ramset/Red Head.
    - e. Powers Fasteners.
    - f. Simpson Strong Tie Anchor Systems.
  4. For post-tensioned concrete, anchors shall not exceed **1 in (25 mm)** embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.
- C. Metal Framing Screws: Screw fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten metal framing and furring members securely to substrates involved; complying with recommendations of gypsum board manufacturers for applications indicated.
- D. Gypsum Board Screws:
1. Material Quality Standards:
    - a. Metal Framing Members less than 0.03 in (0.75 mm) Thick: ASTM C 1002, Type S.
    - b. Metal Framing Members from 0.033 in to 0.112 in (0.79 mm to 2.9 mm) Thick: ASTM C 954, Type S-12.
  2. Product Description - Standard Applications: Bugle head, self-drilling, self-tapping, steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; minimum **1 in (25 mm)** long; with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
  3. Product Description - High Moisture / Humidity Applications: Bugle head, self-drilling, self-tapping, stainless steel screws with Phillips-head recess of size, holding power, and other properties recommended by respective gypsum board manufacturer; for use at high moisture areas such as Kitchens, Showers and Tub Enclosures, Saunas, Steam Rooms, and Pool Enclosures.

- E. Miscellaneous Fasteners: For conditions not indicated, fasteners shall be type, finish, size, and holding power recommended by respective gypsum board manufacturer and conditions.

## **2.10 JOINT TREATMENT MATERIALS**

- A. Material Quality Standard: ASTM C 475 / C 475M.
- B. Joint Tape:
  - 1. Paper Tape: Nominal 2 in (50 mm) wide cross-fibered paper tape with finish suitable for bonding, creased in center for easy folding, and compatible with joint compound.
  - 2. Mesh Tape: Nominal 2 in (50 mm) wide self-adhering 10-by-10 fiberglass mesh tape.
- C. Joint Compound:
  - 1. Setting-Type: Job-mixed powder for mixing with water, chemical-hardening compound; includes taping types.
  - 2. Drying-Type: Ready-mixed or job-mixed powder for mixing with water, air-drying, vinyl based compounds; includes taping, topping, and all-purpose types.

## **2.11 INTERIOR SURFACING COMPOUNDS**

- A. Level 5 Primer and Surfacer: Latex based compound containing polyvinyl acetate (PVA) polymer that can be spray or roller applied to change a Level 4 finish to a Level 5 finish.
  - 1. Manufacturers and Products:
    - a. CertainTeed Corporation; ProRoc Level V Wall and Ceiling Primer/Surfacer.
    - b. United States Gypsum Company (USG); Sheetrock Brand Tuff-Hide Primer-Surfacer.
- B. Concrete Surfacing Compound: Vinyl-based, factory-formulated product applied in two or more coats as necessary for filling and smoothing to provide monolithic concrete surfaces to match Gypsum Board Level 4 finish.
  - 1. Basis of Design: United States Gypsum Company (USG); Cover Coat Brand Compound.

## **2.12 RELATED MATERIALS**

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced quality standards and recommendations of gypsum board manufacturer.
- B. Firestopping Products at Penetrations: As specified in Division 07 Section "Penetration Firestopping".
- C. Fiberglass Sound Attenuation Blankets:
  - 1. Material Quality Standard: ASTM C 665, Type I.
  - 2. Description: Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder.
  - 3. Description: Unfaced blankets produced by bonding inorganic glass fibers with a thermosetting binder; free of formaldehyde.
  - 4. Surface Burning Characteristics: According to ASTM E 84/NFPA 255/UL 723:

- a. Flame Spread: Class A - no greater than 25.
  - b. Smoke Developed: No greater than 50.
5. Thickness: Not less than 2-1/2 in (62 mm), unless otherwise indicated.
6. Manufacturers and Products:
- a. CertainTeed Corporation; CertaPro AcoustaTherm Batts.
  - b. Johns Manville Building Insulation Div.; Sound Control Batts.
  - c. Knauf Fiber Glass; QuietTherm.
  - d. Owens Corning; Sound Attenuation Batts.
7. Basis of Design: Johns Manville; Sound Control Batts, Formaldehyde Free.

D. Mineral Wool Sound Attenuation Blankets:

- 1. Material Quality Standard: ASTM C 665, Type I.
- 2. Description: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of rock or slag with thermosetting resins.
- 3. Surface Burning Characteristics: According to ASTM E 84/NFPA 255/UL 723:
  - a. Flame Spread: Class A - no greater than 25.
  - b. Smoke Developed: No greater than 50.
- 4. Thickness: Not less than 3 in (75 mm), unless otherwise indicated.
- 5. Density: Not less than nominal 2.5 pounds per cubic foot.
- 6. Manufacturers:
  - a. Fibrex Insulations, Inc.
  - b. Rock Wool Manufacturing Co.
  - c. Roxul.
  - d. Thermafiber LLC.

E. Acoustical Sealant for Non-Fire Resistance Rated Joints:

- 1. Description: Manufacturer's standard nonsag, paintable, nonstaining sealant complying with ASTM C 834 or ASTM C 920. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90 or other acceptable test method.
  - a. Preconstruction Compatibility Testing: Test sealant for compatibility with copper substrates. Testing will not be required if data submitted on previous testing of current sealant products matches those submitted.
  - b. Do not use acrylic, neoprene, and nitrile based sealants that are not recommended for use with copper substrates.

F. Fire-Resistance Rated and Acoustical Putty Pads:

- 1. Product Quality Standard: UL 263 (ASTM E 119).
- 2. Description: Fire-rated, non-hardening, moldable, intumescent compound formed into sheets designed to seal penetrations, construction gaps, and around electrical boxes against spread of fire, smoke, and toxic gases.
- 3. Manufacturers and Products:

- a. Grace Construction Products; Flamesafe FSP 1077 Putty Pads.
- b. Hilti; CP 617 Intumescent Acoustic Putty Pads.
- c. Hilti; CFS-P PA.
- d. Specified Technologies, Inc; Series SSP Putty Pads.
- e. Tremco; TREMstop Electrical Box Insert.
- f. 3M; Fire Barrier Moldable Putty+Pads.

G. One-Piece Barrier Box:

- 1. Description: Rigid reinforced polyethylene box designed to fit around electrical boxes to prevent leaks of air and vapor.
- 2. Basis of Design: Lessco Air-Vapor Barrier Box.

H. Fire Resistive Sealants: Intumescent elastomeric sealant as specified in Division 07 Section "Fire-Resistive Joint Firestopping".

I. Sealants: Sealant as specified in Division 07 Section "Joint Sealants".

J. Isolation Strips: Adhesive-backed, closed cell neoprene or vinyl foam strips that allow fastener penetration with foam displacement, size as indicated, compressed 50 percent.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
- 1. Respective Manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
  - 4. Gypsum Association GA 216.
  - 5. United States Gypsum Company (USG); Gypsum Construction Handbook, if no other installation quality standard applies to condition.

- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

#### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

- B. Suspended Gypsum Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hanger wires at spacing required to support ceilings and that hangers will develop their full strength.
- C. Coordination with Sprayed Fire-Resistance Materials:
  - 1. Pre-Application Coordination: Before sprayed fire-resistance materials are applied, attach Z shaped clips and offset mounting plates to structural steel members with powder actuated fasteners, leaving portion of flange exposed outside of sprayed fire-resistive materials to attach head of wall track for gypsum board assembly.
  - 2. Post-Application Coordination: After sprayed fire-resistive materials are applied, remove materials only to extent necessary for installation of gypsum board assemblies, attach Z shaped clips and offset mounting plates to structural steel members with powder actuated fasteners, leaving portion of flange exposed outside of sprayed fire-resistive materials to attach head of wall track for gypsum board assembly, and patch with fire-resistive material specified in Division 07 Section "Cementitious Fireproofing" that is required to obtain fire-resistance rating indicated.

### **3.4 INSTALLATION OF GYPSUM BOARD ASSEMBLIES**

- A. Comply with ASTM C 840.
- B. Resistance Rated Partitions: Construct fire resistance rated, smoke resistance rated, and sound resistance rated partitions according to respective assembly test reports. Ensure every material used within an assembly shall comply with manufacturers listed and product qualities indicated in respective assembly test report.
- C. Penetrations and Openings: Construct within gypsum board assemblies work as required to properly form penetration or opening to receive firestopping materials specified in following Sections:
  - 1. Division 07 Section "Penetration Firestopping".
  - 2. Division 07 Section "Fire-Resistive Joint Firestopping".
- D. Control Joints: Install control joints at locations indicated on Drawings, in specific locations approved by Architect for visual effect and according to the following:
  - 1. Spaced not more than 30 feet in either direction for uninterrupted straight planes of ceilings and walls.
  - 2. Where different substrates occur at ceilings and walls.
  - 3. Where control joints occur in substrates at ceilings and walls.
  - 4. Where L, U, or T shaped ceiling configurations are joined.
  - 5. At less-than-ceiling-height cased opening frames and gypsum board openings over 60 inches in width; extend control joints from both corners at top of frame or opening up to ceiling.
  - 6. Where less-than-ceiling-height door frames occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling at corner of hinge side of door
  - 7. Where less-than-ceiling-height borrowed lites occur on walls more than 30 feet in length; extend control joints from top of frame up to ceiling and from bottom of frame to floor at both corners.

- E. Isolation from Building Structure: Isolate gypsum board assemblies from building structure to prevent transfer of loading imposed by structural movement.
  - 1. Provide isolation joints as indicated or required by installation quality standards.
  - 2. Isolate ceiling assemblies abutting or penetrated by building structure.
  - 3. Isolate partition framing and wall furring abutting or penetrated by building structure, except at floor.
- F. Building Expansion Joints: Avoid bridging building expansion joints with metal framing or furring members; frame both sides of joints independently with framing or furring members, coordinating with building expansion joint products specified in Division 07 Section "Expansion Control".
- G. Fire-Resistance Rated and Acoustical Putty Pads: Hand apply pads to surfaces indicated, packing tightly into gaps and openings, in such a manner that pad will remain secured to surface; pinch pleat excess material together to close gaps.
- H. One-Piece Barrier Box: Install in accordance with manufacturer's recommendations as indicated on the Drawings.
- I. Supplemental Accessories: Install supplementary framing, blocking, reinforcing, and bracing in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, hand rails, furnishings, or similar construction. Comply with details indicated and recommendations of installation quality standards or manufacturer.

### **3.5 INSTALLING SUSPENDED GRID SYSTEM FOR INTERIOR CEILINGS**

- A. Installation Quality Standard: In addition to standards listed elsewhere, perform suspended ceiling work according to following, unless otherwise specified in this Section:
  - 1. ASTM C 636 / C 636M.
- B. Pattern: Lay out spaces and arrange suspension system in a regular pattern, parallel or perpendicular to surrounding walls.
- C. Hangers for Ceiling System: Suspend hangers from building structural members and as follows:
  - 1. Install hangers plumb and free from contact with mechanical and electrical equipment, insulation or other objects within ceiling plenum that are not part of supporting structural frame or ceiling suspension system. Within limitations allowed by installation quality standards, 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 location of hangers required to support suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by installation quality standards.
  - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.



4. Secure the appropriate hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, 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. Install metal framing components for suspended ceilings so that members are level to within 1/8 in in 12 ft (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.
  6. Attach hangers to structural members.
  7. Do not connect or suspend any ceiling components from ducts, pipes or conduit.
- D. Perimeters: Using gypsum board screws through gypsum board into metal studs, attach perimeter wall angle where suspended grid system meets vertical surfaces unless otherwise indicated; cut main beams and cross furring members to fit into wall angle.
- E. Main Beams:
1. Suspend main beams spaced 48 in (1200 mm) on center from structure with wire hangers spaced not greater than 48 in (1200 mm) on center.
  2. Install main beams level within 1/8 in in 12 ft (3 mm in 3.6 m) with hanger wire taut and tightly wrapped to prevent vertical movement or rotation.
  3. Do not make local kinks or bends in hanger wires as a means of leveling.
- F. Cross Furring Members:
1. Install cross furring members at right angles to main beams, spaced as required and join to main beams with positive interlock.
  2. Install cross furring members to within 1/32 in (0.8 mm) of their required location and within 0.015 in (0.38 mm) of same horizontal plane as main beam, and never below continuous member.
  3. Install additional cross furring members at right angles to beams and cross furring members to support ends of recessed light fixtures, diffusers or grilles.
- G. Seismic Conditions: Install bracing wires, compression struts, and other components as required by installation quality standard.

### **3.6 INSTALLING METAL FRAMING COMPONENTS**

- A. Priority: Assemble various assemblies giving priority to partitions with higher rating; extend partition with higher rating intact through partition with lower rating.
- B. Joinery and Connections: Install various metal framing components according to details indicated; for situations and conditions not indicated, comply with installation quality standards and with respective manufacturer's recommendations.
- C. General Requirements: Construct partition framing of studs, tracks, and headers using screws of number and spacing required.
1. Install studs of uncoated base metal thickness as determined by Metal Framing Schedule at end of this Section.
  2. Extend partition framing full height to underside of structure above, except where partitions are indicated to terminate at, or immediately above, suspended ceilings.
  3. Continue framing over door frames and openings to provide support for gypsum board.
  4. Space studs as indicated on Metal Framing Schedule at end of this section.

5. Cut studs 1 in (25 mm) short of full height to provide deflection relief at head of wall conditions.
6. Install studs so that flanges point in same direction.
7. Attach with screws through each stud flange and track (runner) flange, except top deflection track assemblies.
8. For fire resistance rated, smoke resistance rated, and sound resistance rated assemblies that are required to extend to underside of structure above to obtain ratings, install framing around structural and other members extending below floor slabs or roof decks, as needed to support gypsum board closures and make partitions continuous from floor to underside of structure above.
9. Do not lap studs.
10. At intersections and corners, locate studs no more than 2 in (50 mm) from partition intersections and corners and secure with screws through both flanges of studs and tracks.

D. Metal Track (Runner) Requirements:

1. Floors: Install tracks (runners) using appropriate fasteners spaced not more than 16 in (400 mm) on centers.
2. Head of Wall: Install deep leg deflection tracks using appropriate fasteners to laterally support assembly, and to avoid axial loading of assembly by deflection from building structure above.
3. Head of Wall: Where indicated, install proprietary deflection and firestop track (runner) using appropriate fasteners for the substrate and installation conditions.

E. Support for Wall Mounted Accessories or Equipment: Install back-up plate or track (runner) turned on its side, using screws as indicated or as required, to studs to properly transfer accessory or equipment load to metal framing.

F. Openings: Frame single door, double door, above ceiling openings, and below ceiling openings using studs, tracks (runners), clip angles, and headers.

1. Install 2 studs on each side of each opening in configuration indicated, including strap plates; extend from floor to underside of structure above; do not cut these studs under any circumstances. Include sound attenuation blankets within cavity when partition is scheduled to have a sound resistance rating.
2. Construct header of appropriate configuration for type of opening to be spanned and secure with clip angles; include sound attenuation blankets within cavity when partition is scheduled to have a sound resistance rating.
3. Install short intermediate studs 16 in (400 mm) on center between top track and header.
4. At partitions indicated to terminate immediately above ceiling, install diagonal bracing at not less than spacing as indicated.

G. Supplementary Framing: Install around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by metal framing.

H. Penetrations: Maintain fire-resistance rating of assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

I. Chase Partitions:

1. Position double row of studs vertically in tracks (runners), opposite each other in pairs with flanges pointing in same direction.
2. Attach with screws through each stud flange and track (runner) flange.
3. Cross brace between rows of studs with one of following at 48 in (1200 mm) on center maximum vertically, attached to stud webs with screws:
  - a. Coated glass-mat gypsum board, 12 in (300 mm) high by chase width.
  - b. Metal studs turned on side, webs back-to-back.

J. Furred Walls:

1. Erect furring channels vertically, spaced 16 in (400 mm) on centers maximum, unless otherwise indicated.
2. Attach with appropriate fasteners, staggered on flanges.
3. Splice ends by nesting channels 8 in (200 mm) and securely anchoring to surface.
4. Miter 24 in (600 mm) long horizontal furring channels at corners and space 24 in (600 mm) on centers vertically.
5. Locate furring channels around perimeter of openings and secure to surfaces.

K. Control Joints:

1. Construct metal framing as indicated by installation quality standard to allow gypsum board control joints to function as intended.
2. For control joints located in fire resistance rated walls and partitions, construct of metal studs and mineral wool, full height of partition, according to assembly fire test reports.

L. Metal Framing Spanning Multiple Floors: Construct metal framing as required using longest length metal studs possible and attach to building structure with floor bypass clips.

M. Curved Partitions:

1. Metal Track (Runner) shall comply with one of following:
  - a. Field Fabricated From Straight Components:
    - 1) Cut top and bottom runners (tracks) through leg and web at 2 in (50 mm) intervals for arc length. In cutting lengths of runners allow for uncut straight lengths of not less than 12 in (300 mm) at ends of arcs.
    - 2) Bend runners to uniform curve of radius indicated and locate straight lengths so they are tangent to arcs.
    - 3) Support outside (cut) leg of runners by clinching a 1 in (25 mm) high by runner thickness sheet metal strip to inside of cut legs using metal lock fasteners.
  - b. Field crimped using a crimping tool.
  - c. Manufactured flexible products.
2. For full height partitions, attach runners to structural elements at floor and ceiling with appropriate fasteners located 2 in (50 mm) from ends and spaced 12 in (300 mm) on centers.
3. For ceiling height partitions, attach runners to suspended ceilings with toggle bolts or hollow wall anchors located 2 in (50 mm) from ends and spaced 8 in (200 mm) on centers in between where attached to suspended ceilings.

4. Position studs vertically with open sides facing in same direction and engaging floor and ceiling runners.
5. Begin and end each arc with a stud and space intermediate studs equally along arcs at stud spacing recommended by gypsum board manufacturer for radii indicated.
6. Attach studs to runners with 3/8 in (10 mm) long pan head framing screws. On straight lengths at ends of arcs, place studs 6 in (150 mm) on centers with last stud left free standing.

N. Installation Tolerances: Install each metal stud metal framing and furring member so that fastening surfaces do not vary more than 1/8 in (3 mm) from plane formed by faces of framing members.

### **3.7 INSTALLING GYPSUM BOARD PRODUCTS**

A. General Requirements:

1. Install type of gypsum board at location indicated by gypsum board schedule at end of this Section.
2. Do not install damaged gypsum boards.
3. Install gypsum boards with finishable face side out.
4. Butt gypsum boards together for a light contact at edges and ends with not more than 1/16 in (1.5 mm) of open space between panels.
5. Do not force gypsum boards into place.
6. Do not place tapered edges against cut edges or ends.
7. Locate panel joints so that no joint will align with the edge of an opening unless control joints are installed at these locations.

B. Isolation from Building Structure:

1. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments or surfaces where movement is anticipated. Provide 1/4 in to 1/2 in (6 mm in 12 mm) wide spaces at these locations or as indicated below:
  - a. At top of wall or where partitions intersect open building structure members projecting below underside of floor slabs and roof decks, cut to fit profile formed by coffers, joists, beams, and other structural members; form proper annular joint to receive firestopping at rated partitions and form 3/4 in (20 mm) joint at top of wall at non-rated partitions.
2. Trim edges with edge trim where edges of gypsum boards are exposed.
3. Seal joints between edges and abutting structural surfaces with firestopping at rated locations and acoustical sealant at non-rated locations.

C. Single-Layer Board Assemblies:

1. At typical conditions, install gypsum board vertically (long dimension parallel to metal framing), to minimize short end-to-short end joints unless otherwise indicated or required by assembly fire test reports.
2. At interior of stairwells and other high walls, install gypsum boards horizontally, unless otherwise indicated or required by assembly fire test reports. Stagger abutting end joints not less than one framing member in alternate courses of gypsum boards.

- D. Multi-Layer Board Assemblies: Apply base layers and face layers vertically (long dimension parallel to metal framing) with joints of base layers located over stud or furring member and face layer joints offset at least one stud space from base layer joints, unless otherwise indicated or required by assembly fire test reports. Stagger joints on opposite sides of partitions.
- E. Ceiling Applications:
1. Apply gypsum board at right angles to main beams of suspension framing to minimize number of abutting end joints and avoid abutting end joints in central area of each ceiling.
  2. Stagger abutting end joints of adjacent panels not less than one framing member.
  3. Locate both edge or end joints of gypsum boards over intermediate supports or gypsum board back-blocking where metal framing is not present.
- F. Typical Wall Applications:
1. Attach gypsum boards to metal studs so that leading edge or end of each board is attached to open (unsupported) edges of stud flanges first.
  2. Stagger vertical joints on opposite sides of partitions.
  3. Do not make joints other than control joints at corners of framed openings.
  4. Attach gypsum boards to framing provided at doors, openings and cutouts. Install gypsum boards over door heads and extend to not less than one stud space - 16 in (400 mm) at each side of door or opening.
  5. Cover both faces of metal framing with gypsum boards as indicated, except in chase walls that are braced internally.
  6. Cut and fit gypsum boards around ducts, pipes, conduits, and other penetrations to form proper annular joint to receive firestopping at rated partitions.
    - a. At non-rated partitions, annular space around ducts, pipes, conduit or other penetrations to be properly sized to receive sealant; 3/4 in (20 mm) maximum.
    - b. "Blow-out" patches are not allowed.
  7. Support both edge and end joints of gypsum boards over metal framing.
- G. Curved Wall Assemblies:
1. Install 2 layers of flexible gypsum board horizontally and unbroken, to extent possible, across curved surface plus 12 in (300 mm) long straight sections at ends of curves and tangent to them.
  2. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum boards to studs as they are wrapped around curve. On concave side, start fastening gypsum boards to stud at center of curve and work outward to panel ends.
  3. Fasten base layer to studs with screws spaced 16 in (400 mm) on centers maximum. Center second layer over joints in base layer, and fasten to studs with screws spaced 12 in (300 mm) on centers maximum.
- H. Screw Attachments:
1. Attach gypsum board to metal framing with screw fasteners of type appropriate for gypsum board materials and installation conditions:
    - a. Length shall be as required by condition and penetrating metal framing not less than 3/8 in (10 mm).

- b. Spacing shall be as recommended by installation quality standard, gypsum board manufacturer, or respective assembly test report.
    - c. Use properly adjusted, positive-clutch electric power tool equipped with adjustable screw-depth head and a Phillips bit. Nails and staples are not permitted.
  - 2. Drive screws to slightly dimple surface without breaking face paper, fracturing core, or stripping metal framing member around screw shank.
  - 3. Space screws for non-fire resistance rated partitions and ceilings as recommended by installation quality standards.
  - 4. Space screws for fire resistance rated partitions as required by assembly fire test reports.
  - 5. Start field screwing near center and work towards edges.
  - 6. Space screws not less than 3/8 in (10 mm) from gypsum boards edges.
  - 7. Do not attach gypsum boards to top runner where wall or partition extends to building structure unless required by fire test reports.
- I. Control Joints: Form control joints and expansion joints at locations indicated with required space between edges of adjoining gypsum boards.
  - J. Sound Attenuation Blankets: Install blankets within stud cavities set so that they are held in place by friction with metal studs; ensure blankets are secure within cavity and will not become displaced when second gypsum board side is closed.
  - K. Elevator Shaft Cants: Where gypsum board shaftwall assemblies cannot be positioned within 4 in (100 mm) of shaft face of structural beams, floor edges, and similar projections into shaft, install 5/8 in (15 mm) thick gypsum board cants covering tops of projections.
    - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 in (600 mm) on centers with screws fastened to shaftwall framing.
    - 2. Where steel framing is required to support gypsum board cants, install framing at 24 in (600 mm) on centers and extend studs from projection to shaftwall framing.
  - L. Sealant:
    - 1. Comply with ASTM C 919 and manufacturers written recommendations for closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
    - 2. Seal wall assemblies at perimeters, behind control joints, and at openings and penetrations with a continuous bead of sealant material according to following:
      - a. Fire Resistance Sealant: Joints within fire resistance rated assemblies.
      - b. Water Resistance Sealant: Joints within non-fire resistance rated assemblies exposed to possible water infiltration.
      - c. Acoustical Sealant: All other joints.

### **3.8 INSTALLING TRIM ACCESSORIES**

- A. General: Fasten trim accessories continuously according to accessory manufacturer's instructions using gypsum board screws; installation by clinch-on tool and staples not permitted.
- B. Interior Trim Accessories: Install in the following locations:

1. Corner Beads: Install trim at external corners; use screws at each flange at 9 in (225 mm) on centers, opposite each other.
  2. Edge Trim: Install trim where gypsum boards abut dissimilar material, and where edge of gypsum boards would otherwise be exposed; use screws at flange at 9 in (225 mm) on centers.
    - a. LC-Bead (J-Bead): Install trim at exposed conditions where back flange can be attached to framing or supporting substrate before gypsum board installation.
    - b. L-Bead: Install trim at exposed conditions where trim can only be installed after gypsum board installation.
    - c. J-Stop: Install trim at concealed conditions where trim can only be installed after gypsum board installation.
  3. Control Joints: Install trim at appropriate locations, ensuring gypsum board is not continuous over joint; use screws at each flange at 6 in (150 mm) on centers.
    - a. Control joints to extend 4 in (100 mm) above finished ceiling at non-rated conditions and extend to structure at rated wall conditions.
- C. Accent Trim Accessories: Install at locations indicated, mitering corners and intersections to form tight, flush and uniform joints; use screws at each flange at 9 in (225 mm) on centers.
- D. Trim Accessories at Exterior Windows: Install at locations indicated, mitering corners and intersections to form tight, flush and uniform joints; use screws at each flange at 9 in (225 mm) on centers or as recommended by manufacturer for manufactured products.

### **3.9 FINISHING GYPSUM BOARD PRODUCTS**

- A. General: Treat board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare surfaces for decoration.
- B. Joint Tape: Finish joints according to following:
  1. Typical Paper-Faced Gypsum Board: Paper.
  2. Moisture-Resistant Paper-Faced Gypsum Board: Mesh tape.
- C. Finishing: Finish boards and units to achieve specified level of finish as indicated in schedule at end of Section:
  1. Typical Paper-Faced Gypsum Board: Either or combination of the following as recommended by manufacturer:
    - a. Setting-type joint compounds.
    - b. Drying-type joint compounds.
  2. Moisture-Resistant Paper-Faced Gypsum Board: Setting-type joint compounds.
  3. Cementitious Backer Unit: Setting-type joint compounds.

### **3.10 INTERIOR SURFACING COMPOUNDS**

- A. Skim Coat Finishing with Joint Compound:
  1. Prepare concrete surfaces for applied finishes.

- a. Grind ridges, fins, and high areas.
  - b. Remove form oil, efflorescence and greasy deposits.
  - c. Fill offsets, voids, bugholes, rock pockets level with surrounding surfaces with joint compound.
  - d. Apply as many coats of joint compound as necessary to eliminate cracks.
  - e. Verify that resulting concrete surface is uniformly smooth and free of irregularities.
2. Apply setting-type joint compound or Level 5 Primer and Surfacer over entire surface in thickness recommended by manufacturer.
- B. Skim Coat Finishing with Concrete Surfacing Compound:
- 1. Prepare concrete surfaces for applied finishes.
    - a. Grind ridges, fins, and high areas.
    - b. Remove form oil, efflorescence and greasy deposits.
    - c. Fill offsets, voids, bugholes, rock pockets level with surrounding surfaces with concrete surfacing compound.
    - d. Apply as many coats of concrete surfacing compound as necessary to eliminate cracks.
    - e. Verify that resulting concrete surface is uniformly smooth and free of irregularities.
  - 2. Apply Concrete Surfacing Compound over entire surface in thickness recommended by manufacturer.

### **3.11 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
- 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics

### **3.12 ADJUSTMENTS**

- A. Damaged Materials: Stored or installed gypsum board materials shall be classified as damaged, defective, and nonconforming Work if they have been exposed to wetness or dampness at any time prior to Substantial Completion or if they exhibit evidence of active or dormant mold or mildew. Damaged materials and assemblies shall be replaced with new and dry materials and assemblies.

### **3.13 PROTECTION**

- A. Procedures: Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions.

### **3.14 METAL FRAMING SCHEDULE**

- A. Metal Stud Framing Schedule:



1. Stud Depth: As indicated on Drawings.
2. Spacing: Maximum 16 in (400 mm) on centers, unless otherwise indicated, or as required to comply with respective assembly test report.
3. Minimum Performance Requirements - unless otherwise indicated:
  - a. Typical Partitions: L/240 at 5 lb/sq ft (239 Pa) lateral load.
  - b. Elevator Shaft Partitions: L/240 at 7.5 lb/sq ft (359 Pa) lateral load.
  - c. Partitions with Tile Facing: L/360 at 7.5 lb/sq ft (359 Pa) lateral load.
  - d. Partitions with Interior Stone Facing Concentrated Loads: Provide delegated engineering to comply with L/720 at 10 lb/sq ft (479 Pa) lateral load.
  - e. Partitions supporting Lead Lined Doors and Frames: Provide delegated engineering to comply with L/480 at 10 lb/sq ft (479 Pa) lateral load.
  - f. Partitions supporting all other Concentrated Loads: Provide delegated engineering to comply with L/360 at 10 lb/sq ft (479 Pa) lateral load
4. Minimum Uncoated Base Metal Thickness:
  - a. Typical Gypsum Board Assemblies: As determined by manufacturer's limiting height engineering data unless otherwise indicated.
    - 1) 25 Gage or 25 Gage Equivalent Studs: Not acceptable.
    - 2) 25 Gage or 25 Gage Equivalent Studs: Typical at partitions without wall-mounted components installed on either side.
    - 3) 22 Gage Studs: Typical partitions unless otherwise indicated.
    - 4) 20 Gage or 20 Gage Equivalent Studs:
      - a) Partitions supporting ceramic or stone tile.
      - b) Partitions with gypsum board on one side only.
      - c) At door jambs.
      - d) Partitions supporting wall hung cabinets or shelving.
      - e) Partitions with lead lining.
    - 5) 20 Gage Studs: Partitions enclosing high-rise elevator shafts and stairwells.
      - a) 20 Gage Equivalent Studs: Allowed only if part of a tested assembly.
    - 6) 16 Gage Studs: Typical at partitions supporting stone facing unless otherwise indicated.
  - b. Gypsum Board Assemblies required to Support Concentrated Loads: As required by delegated engineering professional but not less than minimum uncoated base metal thickness indicated above.
  - c. Gypsum Board Assemblies required to Withstand Seismic Loads: As required by delegated engineering professional but not less than minimum uncoated base metal thickness indicated above.

### **3.15 GYPSUM BOARD SCHEDULE**

- A. Gypsum Board Schedule, General: Install the designated gypsum board product based on exposure classification to water and / or moisture and applied finish system as follows, unless otherwise indicated or scheduled on the Drawings.

- B. No Exposure: Surfaces not normally exposed to water and / or moisture sources including but not limited to the following:
1. Typical walls and ceilings.
    - a. Paint and Wall Coverings Only: Typical paper-faced gypsum board.
    - b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.
  2. Horizontal fire-rated assemblies and ceilings:
    - a. Paint Only: Paper-faced Type C gypsum board.
  3. Walls in acoustical barriers as indicated in the Drawings.
    - a. Paint and Wall Coverings Only: Paper-faced acoustically enhanced gypsum board.
  4. Curved walls:
    - a. Paint and Wall Coverings Only: Paper-faced flexible gypsum board; installed in two layers.
  5. Shaft-Side Face of Shaft-Liner Assemblies:
    - a. No Finish Required: Moisture-resistant paperless glass mat shaft-liner gypsum board.
    - b. No Finish Required: Moisture-resistant paper-faced shaft-liner gypsum board.
- C. Incidental Exposure: Surfaces immediately adjacent to water and / or moisture sources including, but not limited to, the following locations:
1. Walls and ceilings in mechanical equipment rooms and janitor closets.
  2. Walls within 24 inches of centerline of drinking fountains, isolated wall-hung lavatories, and countertop sinks and other similar water sources.
  3. Interior face of exterior walls.
  4. Acceptable gypsum board products for the above listed conditions:
    - a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.
    - b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.
  5. Top of walls above ceilings adjacent to mechanical equipment in corridors.
    - a. Moisture-resistant paperless glass-mat gypsum board.
- D. Direct Exposure: Surfaces normally soaked, saturated, or regularly and frequently exposed to water and / or moisture including, but not limited to, the following locations:
1. Walls and ceilings in toilet rooms and bathrooms including bathtubs and showers:
    - a. Paint and Wall Coverings: Moisture-resistant paper-faced or moisture-resistant paperless glass-mat gypsum board.

- b. Tile and Adhered Sheet/Panel Coverings: Moisture-resistant coated-glass-mat gypsum board.
- 2. Walls and ceilings in saunas, steam rooms, gang showers, and pool enclosures:
  - a. Tile Only: Cementitious backer units.

### **3.16 GYPSUM BOARD FINISHING SCHEDULE**

- A. Gypsum Board Finishing Schedule, General: Finish panels to Levels of Finish indicated below. Apply joint tape over panel joints, except those with trim having flanges not intended for tape. Sand between coats and after last coat to produce a surface free of defects and ready for applied finish system.
  - 1. Levels of Finish: According to ASTM C 840.
- B. Preparation: Apply joint compound at open joints, panel edges, and damaged surface areas.
- C. Level 1: At following locations, embed tape at joints in joint compound unless a higher level of finish is required for fire resistance rated assemblies. Trim accessories to be installed but not embedded in joint compound unless required for fire rating:
  - 1. Ceiling plenum areas above ceilings.
  - 2. Concealed areas.
  - 3. Substrate for interior stone facing.
  - 4. Substrate for interior woodwork.
  - 5. Unfinished areas designated for future expansion.
  - 6. Not used.
- D. Level 2: At following locations, embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges:
  - 1. Substrate for tiling.
  - 2. Not used.
- E. Level 3: At following locations, embed tape and apply separate first and second coats of joint compound to tape, fasteners, and trim flanges:
  - 1. Mechanical, electrical, data and elevator equipment rooms.
  - 2. Stair towers.
  - 3. Not used.
- F. Level 4: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges:
  - 1. Areas to receive paint.
  - 2. Areas to receive wall coverings.
  - 3. Not used.
- G. Level 5: At following locations, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound or Level 5 Primer and Surfacer over entire surface:

1. Areas to receive whiteboard paint or dry erase board coatings.
2. Curved ceilings and partitions.
3. Areas as indicated on the Drawings.
4. Not used.

**END OF SECTION**

## SECTION 09 3000

### TILING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Modular tiles, membrane underlayments, setting materials, grouting materials, accessories, and supplementary items necessary for installation.

##### 1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Module Size: Actual tile size plus joint width indicated.
- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Ceramic (Mosaic) Tile: Tile formed by either the dust-pressed or plastic method, usually 1/4 in to 3/8 in (6 mm to 10 mm) thick, and having a facial area of less than 6 sq in (3900 mm<sup>2</sup>). Ceramic mosaic tile may be of either porcelain or natural clay composition and they may be either plain or with an abrasive mixture throughout.
- E. LHT: Large and Heavy Tile. Tiles are typically larger than 8 in by 8 in (200 mm by 200 mm) or with at least one side greater than 15 in (375 mm) or weigh 5 psf (239 Pa) or heavier and have an ungauged thickness.
- F. Paver Tile: Glazed or unglazed porcelain or natural clay tile formed by dust-pressed method having a facial area of 6 sq in (3900 mm<sup>2</sup>) or more.
- G. Porcelain Tile: A ceramic tile or paver tile that is generally made by the dust-pressed method of a composition resulting in a tile that is dense, impervious, fine grained, and smooth with sharply formed face.
- H. Quarry Tile: Glazed or unglazed tile, made by extrusion process from natural clay or shale usually having a facial area of 6 sq in (3900 mm<sup>2</sup>) or more.
- I. Wall Tile: A glazed tile with a body that is suitable for interior use and which is usually non-vitreous and is not required nor expected to withstand excessive impact or be subject to freezing and thawing conditions.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Include plans of rooms and elevations of walls showing tile and patterns; include sections showing underlayments, setting materials, and grouting materials.
  - 2. Include details showing widths and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification Purposes: Submit samples for each item listed below of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.
  - 1. Tile: Each type and composition of tile and for each color and finish required, at least 12 in (300 mm) square, mounted on rigid panel, and with grouted joints using product complying with specified requirements and in color approved for completed work.
  - 2. Tile Trim and Accessories: Full-size units of each type and for each color required.
  - 3. Metal Edge Strips: 6 in (150 mm) lengths of specified profile.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. List of Materials for Layered Mock-Up for Construction Quality Purposes:
  - 1. Product, material, and equipment names, model numbers, lot numbers, batch numbers, source of supply, and other information required to identify items used.
  - 2. Receipt of list does not constitute acceptance of deviations from Contract Documents, unless such deviations are specifically approved by Architect in writing.
- B. Master Grade Certificates: Submit for each shipment, type, and composition of tile, signed by tile manufacturer and installer.
- C. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- D. Field Quality Control Reports: Written report of testing and inspection required by “Field Quality Control”.
- E. Manufacturer’s Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- F. Warranty: Sample of warranty.
  - 1. Provide manufacturer’s written warranty covering materials and installation (labor) stating obligations, remedies, limitations, and exclusions.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Instructions: Include in operation and maintenance manual required by Division 01 Section "Closeout Requirements". Submit manufacturer’s instructions for maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
1. Furnish quantity of full-size tile and trim units equal to 2 percent of amount installed, for each type, composition, color, pattern, and size.
  2. Furnish quantity of grout equal to 2 percent of amount installed for each type, composition, and color indicated.

## **1.7 QUALITY ASSURANCE**

- A. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
    - b. Build mock-ups in a layered fashion omitting tile in particular areas to reveal underlayment membranes and setting bed installation including but not limited to the following:
      - 1) Tiled floor conditions at thin-set mortar setting beds.
      - 2) Tiled floor conditions at LHT mortar setting beds.
      - 3) Tiled floor conditions at thick-set mortar setting beds.
      - 4) Movement joints at tiled floor conditions.
      - 5) Tiled shower stall including three walls, floor, curb, and threshold.
      - 6) Tiled wall conditions, including one interior corner.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.9 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.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

**1.10 PROJECT CONDITIONS**

- A. Environmental Limitations: Install tile only when construction in room is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

**1.11 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

**1.12 WARRANTY**

- A. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

- 1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

- 1. Selections: As scheduled or as indicated in finish schedule drawing.

**2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

- 1. Tile: For each tile, obtain of same color, finish, composition, and type, from same source and production run.



2. Setting and Grouting Materials: Obtain ingredients of uniform quality for each mortar and grout component from single manufacturer.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. Slip Resistance Requirements for Floor Tile:
  1. Standards: Products and installation shall comply with ANSI A137.1, and state and local accessibility standards.
  2. Floor Tile Slip Resistance: For tile installed on walkway surfaces, provide products with the following value as determined by testing identical products by the DCOF AcuTest Method per ANSI A137.1:
    - a. Walkway Surfaces: Minimum 0.42.

### **2.4 CERAMIC TILE PRODUCTS**

- A. Material Quality Standard: ANSI A137.1 "Specifications for Ceramic Tiling" for types, compositions, and grades of tiling indicated.
  1. Furnish tiling complying with "Standard Grade" requirements, unless otherwise indicated.
- B. Ceramic Tile, General: Thin ceramic surfacing unit made from clay, porcelain, or mixture of ceramic materials, glazed or unglazed, fired above red heat to temperature sufficient to produce specific physical properties and characteristics specified.
- C. Factory Blending: For tile exhibiting color variations, blend tile in factory and package so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- D. Mounting: Where factory-mounted tile is used, provide back- or edge-mounted tile assemblies as standard with manufacturer. Where tile is intended for installation in wet exposure areas, do not use factory mounted tile assemblies unless tile manufacturer states that this type of mounting is suitable for installation indicated.
- E. Factory-Applied Temporary Protective Coating for Epoxy Grout Installations: Where recommended by tile and grout manufacturer, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating tile face surfaces with a continuous protective film that is easily removable without damaging tile or grout. Do not coat unexposed tile surfaces.

### **2.5 GLASS TILE PRODUCTS**

- A. General: Tile having an overall non-crystalline microstructure with Silica Dioxide as the primary constituent and manufactured by one or more of three primary processes: cast, fused or low-temperature coated.
- B. ANSI Glass Tile Standard: Provide glass tile that complies with ANSI A137.2 for types and other characteristics indicated.
  1. Furnish tiling complying with Standard grade requirements unless otherwise indicated.

## **2.6 STONE TILE PRODUCTS**

- A. Stone Tile, General: Natural quarried stone, pre-fabricated into modular tiles having uniform and consistent dimensional tolerances; with sawn backs.
- B. Material Quality Standard:
  - 1. Granite, ASTM C 615.
  - 2. Limestone, ASTM C 568.
  - 3. Marble, ASTM C 503.
  - 4. Slate, ASTM C 629.

## **2.7 WATERPROOF MEMBRANE UNDERLAYMENTS FOR INTERIOR APPLICATIONS**

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is acceptable to authorities having jurisdiction for use as shower pan waterproofing, as selected from one of the following available options. Include primer, pre-fabricated corners, seaming cement, detail tape, sealant, and other standard accessory products required for application provided by membrane manufacturer.
- B. Unfaced Plastic Waterproof Membrane Underlayments:
  - 1. Unfaced Chlorinated-Polyethylene (CPE):
    - a. Description: ASTM D 4068, non-plasticized, chlorinated polyethylene; minimum 0.040 in (1.0 mm) nominal thickness.
    - b. Manufacturer and Product: The Noble Company; Chloraloy.
  - 2. Unfaced Polyvinyl Chloride (PVC):
    - a. Description: ASTM D 4551, flexible polyvinyl chloride sheet; minimum 0.040 in (1.0 mm) nominal thickness.
    - b. Manufacturer and Product: Compotite Corporation; Composeal Blue Vinyl 40.
  - 3. Locations: Thick-set shower pan installations.
- C. Faced Plastic Waterproof Membrane Underlayments:
  - 1. Faced Chlorinated Polyethylene (CPE):
    - a. Description: Non-plasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric; minimum 0.030 in (0.75 mm) nominal thickness.
    - b. Manufacturers and Products:
      - 1) The Noble Company; Nobleseal TS.
      - 2) Laticrete; Hydro Ban Sheet Membrane.
  - 2. Faced Polyvinyl Chloride (PVC):
    - a. Description: ASTM D 4551, multiple layers of polyvinyl chloride sheet heat-fused together and to facings of bondable nonwoven polyester; minimum 0.040 in (1.0 mm) nominal thickness.
    - b. Manufacturer and Product: Compotite Corporation; Composeal Gold.

3. Locations: Thin-set installations at floors, walls, and ceiling; including thin-set shower pan floor installations.

## **2.8 CRACK ISOLATION MEMBRANE UNDERLAYMENTS**

- A. General: Manufacturer's standard product that complies with ANSI A118.12 as selected from one of the following available options. Include primer, pre-fabricated corners, seaming cement, detail tape, sealant, and other standard accessory products required for application provided by membrane manufacturer.
- B. Fluid-Applied Crack Isolation Membrane Underlayment: Not permitted or allowed within shower and bathtub areas.
  1. Description: Manufacturer's proprietary system consisting of liquid applied component and synthetic fabric sheet reinforcement.
  2. Manufacturers and Products:
    - a. ARDEX Engineered Cements; Ardex 8 + 9 Waterproofing and Crack Isolation Membrane.
    - b. Custom Building Products; 9240 Waterproofing and Crack Isolation Membrane.
    - c. Laticrete International Inc.; Laticrete 9235 Waterproof Membrane.
    - d. Laticrete International Inc.; Blue 92 Anti-Fracture Membrane.
    - e. Mapei Corp.; Mapelastic 400.
- C. Faced Chlorinated Polyethylene (CPE) Crack Isolation Membrane Underlayment:
  1. Description: Non-plasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric; minimum 0.030 in (0.75 mm) nominal thickness.
  2. Manufacturer and Product: The Noble Company; NobleSeal CIS.

## **2.9 SETTING (MORTAR AND GROUT) MATERIALS**

- A. Material Quality Standards: ANSI A118 Series as indicated.
- B. Thick-Set Portland Cement Mortar:
  1. Material Quality Standard: ANSI A118.1, with the following physical properties:
    - a. Cleavage Membrane: One of the following:
      - 1) Any membrane underlayment product listed and designated by manufacturer to be suitable for thick-set applications.
      - 2) Polyethylene Sheeting: ASTM D 4397, minimum 4 mils (0.10 mm) thick.
    - b. Portland Cement: ASTM C 150, Type I, grey color. Use white color with light colored stone, translucent marble or light color grout as recommended by manufacturer.
    - c. Hydrated Lime: ASTM C 206, Type S or ASTM C 207, Type S.
    - d. Aggregate: ASTM C 144, washed clean and graded natural sand passing 16-mesh sieve.
    - e. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2x2 W0.3/0.3 (2 in by 2 in, 16/16 wire) (50 mm by 50 mm MW2.0/2.0); comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
    - f. Suitable for use in thick set mortar beds up to 2 in (50 mm) thick.

C. LHT Latex-Portland Cement Mortar:

1. Material Quality Standard: ANSI A118.4, with the following physical properties:
  - a. Manufacturer's premium polymer modified LHT mortar product; gray color. Use white color with light colored stone, translucent marble or light color grout as recommended by manufacturer.
  - b. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
  - c. Non-sag capability.
  - d. Suitable for use in LHT mortar beds up to 1/2 in (12 mm) thick.
2. Manufacturers and Products - Floor Tiling:
  - a. ARDEX Engineered Cements; X 77 Microtec.
  - b. Custom Building Products; ProLite Tile & Stone Mortar.
  - c. Laticrete International, Inc.; Laticrete 255 MultiMax.
  - d. Mapei Corp.; Ultraflex LFT Mortar.

D. Thin-Set Latex-Portland Cement Mortar (For All Tile Types Except Glass):

1. Material Quality Standard: ANSI A118.4, with the following physical properties:
  - a. Manufacturer's premium polymer modified thin-set product; gray color. Use white color with light colored stone, translucent marble or light color grout as recommended by manufacturer.
  - b. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
  - c. Non-sag capability.
  - d. Suitable for use in thin set mortar beds up to 1/4 in (6 mm) thick.
2. Manufacturers and Products - Floor Tiling:
  - a. ARDEX Engineered Cements; X 77 Microtec.
  - b. Custom Building Products; ProLite Tile & Stone Mortar.
  - c. Laticrete International, Inc.; Laticrete 254 Platinum Thin-Set Mortar.
  - d. Mapei Corp.; Ultraflex 3 Mortar.
3. Manufacturers and Products - Wall Tiling:
  - a. ARDEX Engineered Cements; X 77 Microtec.
  - b. Custom Building Products; ProLite Tile & Stone Mortar.
  - c. Laticrete International, Inc.; Laticrete 255 MultiMax Multipurpose Thin-Set Mortar.
  - d. Mapei Corp.; Ultralite Mortar.

E. Thin-Set Mortar for Glass Tile:

1. Material Quality Standard: ANSI A118.4, manufacturer's premium, glass tile mortar.
2. Manufacturers and Products:
  - a. ARDEX Engineered Cements; X 77 Microtec.
  - b. Custom Building Products; Glass Tile Premium Thin-Set Mortar.
  - c. Laticrete International, Inc.; Glass Tile Adhesive.
  - d. Mapei Corp.; Mosaic & Glass Tile Mortar.

F. Epoxy Mortar:

1. Material Quality Standard: ANSI A118.3, with the following physical properties:
  - a. 100 percent solids.
  - b. Chemical-resistant, water-cleanable, multiple component product.
  - c. Resistant to intermittent exposure to temperatures of up to 212 deg F. (100 deg C.).
  - d. Rated extra heavy service according to ASTM C 627.
  - e. Will not stain when used for stone tile, and acceptable to stone supplier.
2. Manufacturers and Products:
  - a. ARDEX Engineered Cements; WA Epoxy Grout and Adhesive.
  - b. Custom Building Products; EBM Lite Epoxy Bonding Mortar.
  - c. Laticrete International, Inc.; Latapoxy 300.
  - d. Mapei Corp.; Kerapoxy 410.

G. Latex-Portland Cement Grout for Tile Joints:

1. Unsanded Grout:
  - a. Material Quality Standard: ANSI A118.7, with following physical properties:
    - 1) Manufacturer's premium polymer modified unsanded grout product.
    - 2) Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
  - b. Manufacturers and Products:
    - 1) ARDEX Engineered Cements; FG-C Unsanded Grout.
    - 2) Custom Building Products; Prism Surecolor Grout.
    - 3) Laticrete International, Inc.; Permacolor Grout.
    - 4) Mapei Corp.; Ultracolor Plus Grout.
  - c. Locations: Tile Joints less than 1/8 in (3 mm) wide.
2. Sanded Grout:
  - a. Material Quality Standard: ANSI A118.7, with following physical properties:
    - 1) Manufacturer's premium polymer modified sanded grout product.
    - 2) Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
  - b. Manufacturers and Products:
    - 1) ARDEX Engineered Cements; FL Rapid Set, Flexible, Sanded Grout.
    - 2) Custom Building Products; Prism Surecolor Grout.
    - 3) Laticrete International, Inc.; Permacolor Grout.
    - 4) Mapei Corp.; Ultracolor Plus Grout.
  - c. Locations: Tile Joints 1/8 in (3 mm) wide and larger.

H. Epoxy Grout:

1. Material Quality Standard: ANSI A118.3, with following physical properties:
  - a. 100 percent solids.
  - b. Chemical-resistant, water-cleanable, multiple-component product.
  - c. Resistant to intermittent exposure to temperatures of up to 212 deg F. (100 deg C.).
  - d. Mold and mildew resistant.
  
2. Manufacturers and Products:
  - a. ARDEX Engineered Cements; WA Epoxy Grout.
  - b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout.
  - c. Laticrete International, Inc.; Latapoxy 2000 Industrial Grout.
  - d. Mapei Corp.; Kerapoxy IEG CQ.
  
- I. Proprietary Epoxy Grout: Proprietary high performance epoxy grout; provides high degree of stain resistance; cleanable to the original color.
  1. Material Quality Standard: ANSI A118.3.
  2. Manufacturers and Products:
    - a. Laticrete International, Inc.; SpectraLOCK PRO Grout.
    - b. Mapei Corp.; Kerapoxy CQ.

## **2.10 ELASTOMERIC SEALANTS**

- A. Sealant Colors: Match color of adjacent grout unless otherwise indicated.
  
- B. Mildew-Resistant Floor or Wall Joint Sealant:
  1. Material Quality Standard: ASTM C 920, Type S, Grade NS, Class 25, with following physical properties:
    - a. Integral antimicrobial product added during manufacturing to resist mold and mildew growth.
    - b. Intended for sealing interior ceramic tile joints and other nonporous substrates.
    - c. Resistant to in-service exposures of high humidity and temperature extremes.
  
  2. Description: One-part mildew-resistant silicone sealant.
  3. Manufacturers and Products:
    - a. ARDEX Engineered Cements; SX.
    - b. Custom Building Products; Commercial 100% Silicone Caulk.
    - c. Dow Corning Corp.; 786.
    - d. Laticrete International, Inc.; Latasil.
    - e. Pecora Corp.; 898.
    - f. Tremco Inc.; Tremsil 200.
  
- C. Chemical Resistant Floor Joint Sealant:
  1. Description: Two-part self-leveling epoxy sealant.
  2. Manufacturers and Products:
    - a. BASF Construction Chemicals; MasterSeal CR 190 (Formerly Sonneborn Epolith-P).

- b. Euclid Chemical Co.; Euco 800.
- c. L&M Construction Chemical Inc.; Epoflex SL.

D. Backer Rods:

- 1. Material Quality Standard: ASTM C 1330, Type B.
- 2. Description: Non-gassing (when punctured), bi-cellular polyethylene or polyolefin foam rod with a surface skin, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- 3. Manufacturers and Products:
  - a. BASF Construction Chemicals; MasterSeal 921 (Formerly Sonneborn Soft Backer Rod).
  - b. Nomaco Inc.; Sof Rod.

- E. Backer Tape: Bond-breaking polyethylene or other plastic tape, self-adhesive where applicable, recommended by sealant manufacturer for preventing sealant from adhering to back of joint where such adhesion would result in sealant failure.

## 2.11 RELATED MATERIALS

- A. Cementitious Underlayments: Trowelable or self-leveling as required by conditions; pre-mixed, latex-modified, Portland cement based formulation provided by or specifically approved by setting material manufacturer; include primers if required for concrete substrate condition.
- B. Patching Compounds: Trowelable pre-mixed, latex-modified, Portland cement based formulation provided by or specifically approved by setting material manufacturer; include primers if required for concrete substrate condition.
- C. Metal Transition Strips (Tile to Adjacent Flooring Material):
  - 1. Schluter Systems LP; Schiene, stainless steel.
- D. Glass-Fiber Tape: Self-adhering, alkali-resistant, glass-fiber tape, 10 by 10 or 10 by 20 threads per 1 in (25 mm).; minimum 2 in (50 mm) wide.
- E. Tile Cleaner: Neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, provided by or specifically approved by tile and grout manufacturers.
- F. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

## 2.12 MIXING MORTARS AND GROUT

- A. General Procedures:
  - 1. Mix to comply with referenced quality standards and manufacturers' written instructions.
  - 2. Add materials, water, and additives in accurate proportions.
  - 3. Use type of mixing equipment, speeds, containers, time, and other procedures to produce uniform quality with optimum performance characteristics for installations indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrate surfaces to which tile will be installed for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with the Contract Documents. Starting work within a particular area will be construed as acceptance.
1. 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.
  2. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standard: In addition to standards listed elsewhere, perform tile work according to following, unless otherwise specified:
1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
  4. ANSI A108 installation method indicated.
  5. TCNA installation method indicated.
- B. General Requirements:
1. Extend tile into recesses and under or behind equipment and fixtures to form a complete covering without interruptions unless otherwise indicated.
  2. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
  3. Accurately form intersections and returns.
  4. Perform cutting and drilling of tile without marring visible surfaces.
  5. Grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints, to form smooth edges.
  6. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile by not less than 1/8 in (3 mm).
- C. Jointing Pattern:
1. Unless otherwise indicated, lay tile in grid pattern.
  2. Align joints when adjoining tiles on floor, base, walls, and trim are same size.
  3. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting.
  4. Provide uniform joint widths of size recommended by tile and grout manufacturer unless otherwise indicated.
  5. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- D. Wainscots: Lay out tile to next full tile beyond dimensions indicated, and finish with bullnose shape.



### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Substrate Cleaning: Remove curing compounds, coatings, laitance, efflorescence, concrete dust, dirt, oil, gypsum board dust, paint, and other residue that would adversely affect or reduce bonding.
- C. Concrete Floor Preparation:
  - 1. Prepare concrete floor substrates to comply with flatness tolerance of 1/4 in in 10 ft (6 mm in 3 m) as follows:
    - a. Fill cracks, holes and depressions with trowelable cementitious underlayments and patching compounds.
    - b. Remove concrete protrusions, bumps, and ridges by sanding or grinding.
  - 2. If substrate does not have fine broom finish, mechanically scarify concrete substrates to not less than ICRI CSP 4 finish.
  - 3. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 in per foot (1:50) toward drains.
- D. Substrate Joints, Gaps, Penetrations, and Different Substrates within Shower and Tub Enclosures: Prior to installing tile, seal the following joints, gaps, and spaces between differing materials as follows:
  - 1. Base of Wall Joints within Shower and Tub Enclosures: Apply wall joint sealant at joint between Coated Glass-Mat Water Resistant Board (specified in Division 09 Section "Gypsum Board Assemblies") and Tub Enclosure or Prefabricated Shower Receptor, Thick-set Mortar Bed, or floor slab to create water resistant barrier in accordance with TCNA Installation B420.
  - 2. Penetrations: Apply wall joint sealant at penetrations through wall substrates to create water resistant barrier; especially at piping and valve penetrations.
  - 3. Toilet Accessories: Apply wall joint sealant at fastener penetrations and around perimeter of backing plates to create water resistant barrier.
  - 4. Joints and Corners: Apply glass-fiber tape to joints and corners of substrates within Showers and Tub Enclosures with thin-set mortar.
- E. Blending: Verify tile has been factory blended and packaged as specified; if not, either return to manufacturer or blend tiles at site before installing.
- F. Field-Applied Temporary Protective Coating: Where needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.4 WATERPROOF MEMBRANE UNDERLAYMENT INSTALLATION

- A. Installation Quality Standard: ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. General Requirements:

1. If required by manufacturer, prime concrete substrate.
2. Install to produce a continuous waterproof membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles or kinks.
3. For sheets, overlap and seal seams.
4. Turn membrane up wall at locations where tile is scheduled for wall or base.
5. Roll installed sheet if required by manufacturer.
6. Install tile after waterproofing has cured and been tested determined it is watertight.

### **3.5 CRACK ISOLATION MEMBRANE UNDERLAYMENT INSTALLATION**

#### **A. General Requirements:**

1. If required by manufacturer, prime concrete substrate.
2. Install to produce a continuous crack isolation membrane of uniform thickness bonded securely to substrate, without wrinkles, bubbles, buckles, or kinks.
3. For sheets, overlap and seal seams.
4. For liquid applied products, brush or roll liquid uniformly over area in number of coats required and install reinforcing fabric.
5. Roll installed sheet if required by manufacturer.
6. After installation of tile, install floor joint sealant in tile joints recommended by manufacturer to coordinate with membrane strips.

### **3.6 TILE INSTALLATION**

#### **A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.**

#### **B. Installation Quality Standard: Install tile according to following standards:**

1. Thick-set Mortar: ANSI A108.1 and A108.5; for recessed subfloor.
2. LHT Mortar: ANSI A108.5; for floor tiles larger than 8 in by 8 in (200 mm by 200 mm) or with at least one side greater than 15 in (375 mm) and where subfloor is not recessed.
3. Thin-set Latex-Portland Cement Mortar: ANSI A108.5; for floor tiles 8 in by 8 in (200 mm by 200 mm) and smaller where subfloor is not recessed; and for interior wall tiles.
4. Epoxy Mortar: ANSI A108.9.
5. Latex-Portland Grout: ANSI A108.10, typical unless indicated otherwise.
6. Epoxy Grout: ANSI A108.9, where indicated.

#### **C. Back Buttering: For following installations, obtain minimum 95 percent mortar coverage as in referenced ANSI A108 series of installation standards:**

1. Exterior tile floors.
2. Tile floors and ceilings in wet and limited water exposures.
3. Tile floors installed with epoxy mortars.
4. Tile floors composed of tiles 12 in by 12 in (300 mm by 300 mm) or larger.
5. Tile floors composed of rib-backed tiles.

#### **D. Grout Joint Widths: Install the respective types of tile with the following grout joint widths, unless otherwise recommended by tiling and grout manufacturers.**

1. Ceramic Mosaic Tile - Less than 6 sq in (3900 mm<sup>2</sup>): 1/16 in (1.5 mm).
2. Paver Tile - 6 sq in (3900 mm<sup>2</sup>) or More: 1/4 in (6 mm).

3. Quarry Tile - 6 sq in (3900 mm<sup>2</sup>) or More: 1/4 in (6 mm).
  4. Stone Tile: 1/4 in (6 mm).
- E. Metal Trim: Install at locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- F. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.7 MOVEMENT JOINTS

- A. Movement Joints, General: Installation Quality Standard: In accordance with TCNA Movement Joint Design Essentials EJ171 and as specified below.
- B. Wall Joints: The following conditions shall not be grouted; install wall joint sealant and backer rod or backer tape:
1. Gypsum board assembly control joints.
  2. Building expansion joints, unless scheduled for expansion joint cover.
  3. Interior corners of tiled walls, including shower and bathtub walls.
  4. Around substrates and tile at penetrations through tiled substrates.
  5. At one side of changes in direction or plane of wall.
  6. At joint closest and parallel to changes in substrates supporting tile between wall and floor.
- C. Floor Joints:
1. General Requirements:
    - a. Where full coverage crack isolation membrane is not provided, continue construction, contraction (control), and expansion joints in building structure through tile work.
    - b. Isolate tile work that abuts a restraining structure or assembly.
    - c. When metal trim or sealant/backer is used for joint, width shall not be less than width of joint in building structure.
    - d. Tile shall not be placed over building expansion joints.
  2. Schedule of Sealant Products and Locations:
    - a. Latex-Portland Cement Grouted Floors: Install floor joint sealant with backer rod at horizontal joints in mortar and grout setting conditions.
    - b. Epoxy Grouted Floors: Install chemical resistant floor joint sealant full depth without backer rod at horizontal joints in epoxy grout setting conditions.
    - c. Epoxy Mortar and Grouted Floors: Install chemical resistant floor joint sealant full depth without backer rod at horizontal joints in epoxy mortar and grout setting conditions.
  3. Interior Movement Joint Spacing: As indicated on Drawings and as specified below:
    - a. Tile Exposed to Direct Sunlight or Moisture: 8 ft to 12 ft (2.4 m to 3.6 m) on center each way.
    - b. Tile Not Exposed to Sunlight: 20 ft to 25 ft (6 m to 7.5 m) on center each way.

D. Interior Floor Joint Installation Schedule: Seal interior floor movement joints, as defined by TCNA, according to following schedule:

1. Construction Joints: Floor joint sealant and backer rod.
2. Contraction (Control) Joints: Floor joint sealant and backer rod.
3. Isolation Joints: Floor joint sealant and backer rod.
4. Tile Expansion Joints: Floor joint sealant and backer rod.
5. Perimeter Joints between Wall and Floors: Floor joint sealant with backer tape.

### **3.8 FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.9 TESTING**

A. Shower Receptor Test: Where shower floors and receptors are made water-tight by the application of the waterproof membrane, the completed membrane installation shall be tested at each installation.

1. The pipe from the shower drain shall be plugged and the receptor area shall be filled with water to a depth of not less than 2 in (50 mm) measured at the threshold.
2. Where a threshold of adequate height does not exist a temporary threshold shall be constructed to retain the test water to the stated depth.
3. The water shall be retained for a test period of not less than 24 hours, and there shall not be evidence of leakage.
4. Report results of tests, both successful and unsuccessful. In addition to results, report shall include date of test, project name, list of products being applied and tested, name of applicator, name of Contractor, and conditions causing failure of waterproofing membrane in event of an unsuccessful test.
5. Materials and installations failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense

### **3.10 CLEANING**

A. Cleaning:

1. Acids are not permitted, nor will they be allowed.
2. Clean tile surfaces so they are free of foreign matter.
3. Remove grout residue from tile as soon as possible.
4. No sooner than 10 days after installation, clean grout smears and haze from tile according to 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.
5. Protect metal surfaces and plumbing fixtures from effects of cleaning.
6. Flush surfaces with clean water before and after cleaning.

7. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

### **3.11 DEMONSTRATION**

- A. Cleaning and Maintenance Training: Provide instruction to Owner's personnel for cleaning and maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use; include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

### **3.12 PROTECTION**

- A. Coverings: When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
- B. Traffic Restrictions: Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

### **3.13 INTERIOR TILE INSTALLATION SCHEDULE**

- A. Floors, Concrete Substrate - Recessed:
  1. TCNA Installation Method F111 (Cleavage Membrane) at Slabs-on-Grade: Thick-set reinforced Portland cement mortar bed over cleavage membrane over concrete subfloor; Latex-Portland Cement Grout.
  2. TCNA Installation Method F121 (Waterproof Membrane) at Elevated Slabs: Thick-set reinforced Portland cement mortar bed over waterproof membrane over concrete subfloor; Latex-Portland Cement Grout.
- B. Floors, Kitchens, and Food Service Areas, Concrete Substrate - Recessed:
  1. TCNA Installation Method F114 (Cleavage Membrane) at Slabs-on-Grade: Thick-set reinforced Portland cement mortar bed over cleavage membrane over concrete subfloor; Epoxy Grout.
  2. TCNA Installation Method F114 (Waterproof Membrane) at Elevated Slabs: Thick-set reinforced Portland cement mortar bed over waterproof membrane over concrete subfloor; Epoxy Grout.
- C. Floors, Kitchens, and Food Service Areas, Concrete Substrate - LHT Mortar:
  1. TCNA Installation Method F115 (Cleavage Membrane) at Slabs-on-Grade: Latex-Portland cement mortar bond coat over concrete subfloor; Epoxy Grout.
  2. TCNA Installation Method F115A (Waterproof Membrane) at Elevated Slabs: Latex-Portland cement mortar bond coat over concrete subfloor; Epoxy Grout.
- D. Floors, Concrete Substrate:
  1. TCNA Installation Method F125-Full (Crack Isolation Membrane; full coverage): Thin-set Latex-Portland cement mortar over crack isolation membrane over concrete subfloor; Latex-Portland Cement Grout.

- a. Location: Where scheduled in the Room Finish Schedule located on the drawings and in all thin-set tile locations which have neither waterproofing nor sound isolation scheduled.
  - 2. TCNA Installation Method F125-Partial (Crack Isolation Membrane; coverage only at visible cracks in substrate): Thin-set Latex-Portland cement mortar over crack isolation membrane over concrete subfloor; Latex-Portland Cement Grout.
    - a. Location: Where scheduled in the Room Finish Schedule located on the drawings and in all thin-set tile locations which have neither waterproofing nor sound isolation scheduled.
  - 3. TCNA Installation Method F122 (Waterproof Membrane): Thin-set Latex-Portland cement mortar over waterproof membrane over concrete subfloor; Latex-Portland Cement Grout.
    - a. Location: As scheduled in the Room Finish Schedule located on the drawings.
  - 4. TCNA Installation Method F122 (Sound Isolation Membrane): Thin-set Latex-Portland cement mortar over sound isolation membrane over concrete subfloor; Latex-Portland Cement Grout.
    - a. Location: As scheduled in the Room Finish Schedule located on the drawings.
- E. Floors, Elevator Car, Cementitious Backer Unit Substrate:
- 1. TCNA Installation Method F144: Thin-set Epoxy mortar over cementitious backer unit; Epoxy Grout.
- F. Walls, Gypsum Board Substrate:
- 1. TCNA Installation Method W243: Thin-set Latex-Portland cement mortar over coated-glass-mat gypsum board; Latex-Portland Cement Grout.
- G. Walls, Concrete or Masonry Substrate:
- 1. TCNA Installation Method W202: Thin-set Latex-Portland cement mortar over concrete or masonry; Latex-Portland Cement Grout.
- H. Walls, Gypsum Board Substrate, Bathtub / Shower Surfaces:
- 1. Walls, Including Tub Unit or Pre-Fabricated Shower Receptors: TCNA Installation Method B419 (Waterproof Membrane): Thin-set Latex-Portland cement mortar over waterproof membrane over coated-glass-mat gypsum board; Latex-Portland Cement Grout.
  - 2. Shower Receptors: TCNA Installation Method B420 (Waterproof Membrane): Thin-set Latex-Portland cement mortar over waterproof membrane over coated-glass-mat gypsum board walls and concrete subfloors; Latex-Portland Cement Grout.

### **3.14 TILE FINISH SCHEDULE**

- A. See Interior Finish Legend on the drawings.

**END OF SECTION**

## SECTION 09 5113

### ACOUSTICAL PANEL CEILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Acoustical lay-in ceiling panels, exposed metal suspension systems, and supplementary items necessary for installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- C. Samples for Verification Purposes: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
  - 1. Acoustical Panels: Set of 6 in (150 mm) square samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 12 in (300 mm) long samples of each type, finish, and color.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: To include in maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
  - 1. Acoustical Ceiling Panels: Full-size units equal to 2 percent of amount installed.
  - 2. Suspension System Components: Quantity of each exposed component equal to 2 percent of amount installed.

##### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.

## **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages 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 stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## **1.9 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, 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.

## **1.10 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corporation.
  - 3. Chicago Metallic Corporation.
  - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
  - 1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer if both are offered by the manufacturer.



## **2.3 PERFORMANCE REQUIREMENTS**

- A. General Performance: Products and systems shall be engineered to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
  - 2. Smoke-Developed Index: 450 or less.
- C. Seismic Standards: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
  - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
  - 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings-Seismic Zones 0-2".
  - 3. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads".

## **2.4 ACOUSTICAL PANELS, GENERAL**

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance's, unless otherwise indicated.
  - 1. Selections: As scheduled or as indicated in Design Selections.

## **2.5 METAL SUSPENSION SYSTEMS, GENERAL**

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
  - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635/C 635, Table 1, "Direct Hung", unless otherwise indicated.
  - 1. Comply with seismic design requirements.
  - 2. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Cast-in-place anchors, designed for attachment to concrete.
  - b. Post-installed expansion anchors.
  - c. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 for Class SC1 service condition.
3. Powder-Actuated Anchors: Suitable for application indicated, ANSI A10.3; low velocity, powder-actuated fasteners; drive pins and clip angles fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, an ultimate load capacity not less than 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.
- a. Manufacturers:
    - 1) Construction Materials, Inc.
    - 2) Heckman Building Products, Inc.
    - 3) Hilti Corp.
    - 4) ITW Ramset/Red Head.
    - 5) Powers Fasteners.
    - 6) Simpson Strong Tie Anchor Systems.
4. For post-tensioned concrete, anchors shall not exceed **1 in (25 mm)** embedment. Obtain Structural Engineer's written approval for all proposed anchors in post-tensioned concrete prior to installation.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
- 1. Wire:
    - a. Zinc-Coated Carbon-Steel Wire: ASTM A 641 / A 641M, Class 1 zinc coating, soft temper.
    - b. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic; for use at MRI and related spaces.
  - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106 in (2.69 mm) diameter wire.
- E. Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces and complying with requirements of authorities having jurisdiction or as recommended by manufacturer.
- F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces and complying with requirements of authorities having jurisdiction.
- G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place and complying with requirements of authorities having jurisdiction.
- H. Edge Moldings and Trim: Manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
- 1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

- I. Wide-Face, Capped, Double-Web, Stainless Steel Suspension System: Main and cross runners roll formed from cold-rolled Type 304 or 316 non-magnetic stainless steel sheet, standard of manufacturer, with 15/16 in (24 mm) wide polished stainless steel caps on flanges.
  1. Structural Classification: Intermediate-duty system.
  2. End Condition of Cross Runners: Override (stepped) type.
  3. Face Design: Flush face.
  4. Cap Material: Polished stainless steel sheet.
  5. Manufacturers and Products:
    - a. Armstrong World Industries, Inc.; SS Prelude Plus XL.
    - b. Chicago Metallic Corporation; 730 System - All Stainless Steel.
    - c. USG Interiors, Inc.; Donn DXSS.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. ASTM C 636 / C 636M.
  2. Respective manufacturer's written installation instructions.
  3. Accepted submittals.
  4. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.
- C. 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, and comply with layout shown on reflected ceiling plans.

### 3.4 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with mechanical and electrical equipment, insulation, or other objects within ceiling plenum that are not part of supporting structural frame or ceiling suspension system. Within limitations allowed by installation quality standards, 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 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by installation quality standards.
  3. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures 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.
  4. Do not support ceilings directly from permanent metal forms. Fasten hangers to cast-in-place hanger inserts, power-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
  5. Do not attach hangers to steel deck tabs.
  6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  7. Space hangers not more than 48 in (1200 mm) on center along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 in (200 mm) from ends of each member.
  8. Do not connect or suspend any ceiling components from ducts, pipes or conduit.
  9. Do not make local kinks or bends in hanger wires as a means of leveling.
- B. Install edge moldings and trim 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 in (400 mm) on center and not more than 3 in (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 in per 12 ft (3 mm per 3.6 m). Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
  4. Provide control joints where joints occur in abutting surfaces.
  5. Hold tees in place with concealed clips.
- C. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
1. Space steel main runners at 48 in (1200 mm) on center.
  2. Space aluminum main runners at 24 in (600 mm) on center.
- D. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels with pattern running in one direction parallel to long axis of space.

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 panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

### **3.5 PROTECTION**

- A. Protect products and systems from damage during installation and remainder of construction period according to manufacturer's instructions.

### **3.6 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. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

### **3.7 ACOUSTICAL PANEL CEILING SCHEDULE**

- A. See Interior Finish schedule on drawings.:

**END OF SECTION**



## SECTION 09 5451

### LINEAR WOOD WALL AND CEILING SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes wood veneer ceiling and wall panels, ceiling suspension system and supplementary items necessary to complete work required for their installation.

##### 1.2 SUBMITTALS

- A. Design Data: Submit complete and specific design data for products specified.
- B. Product Data:
  - 1. Submit manufacturer's specifications to evidence compliance with these specifications.
  - 2. Submit manufacturer's installation instructions.
  - 3. Manufacturer's Product Data shall be clearly marked to indicate specific models or types intended for submittals and desired approval.
  - 4. Product Data which is unmarked or unclear as to intended submittal will be returned unreviewed to submitter.
- C. Samples:
  - 1. Submit 12 inches x 12 inches samples of suspension system showing cross tee connection to main beam.
  - 2. Submit 12 inches long sample of angle molding.
  - 3. Submit 12 inches x 12 inches samples of each type acoustical unit specified.
- D. Shop Drawings: Show complete pattern layout, setting diagrams and arrangement of acoustical units. Show erection details and location of openings in system.
- E. Certification: Submit laboratory certification that acoustical ceiling lay-in panels meets Surface Burning Characteristics requirements specified, per ASTM E 84/NFPA 255/UL 723.

##### 1.3 EXISTING CONDITIONS

- A. Install acoustical treatment after moist materials have been installed.
- B. Maintain temperature and humidity conditions closely approximating interior conditions (min. 25% - max. 55%), which will exist when building is occupied, but not less than 50 deg. or more than 85 deg. F. before, during and after installation.

##### 1.4 MAINTENANCE

- A. Furnish to Owner 2 percent extra of each type panel specified, for future use or replacement.

#### PART 2 - PRODUCTS

##### 2.1 ACCEPTABLE MANUFACTURERS

- A. Product Standards (Basis of Design): Contract Documents are based on products specified to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change intended aesthetic, functional and performance requirements as judged by Architect.
- B. Ceiling and wall Panels Types:
  - 1. As indicated in finish schedule drawing.
- C. Wood planks shall be provided in a width scheduled.
- D. Wood plank length shall be random length up to 10' length (if solid wood) or 8' and/or 10' length (if veneer).
- E. Wood Specie: System shall consist of scheduled solid wood or veneer; wood specie.
- F. Finish: Wood finish shall utilize ACGI clear finish with satin sheen or specify stain to match architect sample. Back of planks shall be factory sealed.
- G. Certification: Wood veneer, wood veneer shall be FSC certified, and the core material shall be FSC certified. If FSC, Chain of Custody shall be provided.
- H. NAUF: If veneer, substrate material shall be manufactured with no added urea formaldehyde.
- I. Fire Rating: Panels shall achieve a Class I(A) or Class II(B) Fire Rating.
- J. Attachment System: Linear Wood Wall and Ceiling System shall be suspended according to manufacturer's suggested method of suspension as per the design details provided in the plans.
- K. Accessories:
  - 1. As required by Manufacturer.

## **2.2 MATERIALS**

- A. Suspension System Components: All linear carriers shall be commercial quality hot dipped galvanized steel as per ASTM A 653. Linear carriers are double-web steel construction with 15/16 inch type concealed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Linear carriers shall have rotary stitching.
  - 1. Structural Classification: ASTM C 635, Heavy Duty.
  - 2. Clips: Integral, factory-applied, spring steel clips on linear carriers in sufficient number to receive 8 foot linear wood (nominal 4 inch) (nominal 6 inch) planks.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than 12 gauge.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION AND PREPARATION**

- A. Examine spaces and correct defects that could interfere with proper installation.



- B. Install suspension system in accordance with ASTM C 636 to produce finished ceiling true to lines and free from warped, soiled or damaged grid.
- C. Install acoustical treatment after moist materials have been installed.
- D. Maintain temperature and humidity conditions closely approximating interior conditions which will exist when building is occupied but not less than 50 deg. or more than 85 deg. F. before, during and after installation.
- E. Lay out spaces and arrange suspension system in regular pattern parallel or perpendicular to surrounding walls.
- F. Arrange system symmetrically about room centerlines in both directions equalizing borders.

### **3.2 SYSTEM INSTALLATION**

- A. Linear wood wall and ceiling system shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by manufacturer.
- B. The contractor shall suspend panels in accordance with manufacturer's recommended installation guides and shop drawings
- C. The ceiling system shall be suspended by 15/16" black HD T-grid with main runners on 2' centers and cross T's every 4'.
- D. Panels shall be installed by screwing LSC-101 and LSC-102 clips into the furring strips (wall) or T-Grid (ceiling) and attaching the wood members in accordance to the manufactures' installation instructions. LSC-103 alignment clips shall be used at plank joints.
- E. Contractor shall clean all panels prior to installation according to manufacturer's recommended maintenance procedures. Upon completion of installation, panels shall be inspected and cleaned as needed.
- F. Concentrated Load Conditions:
  - 1. Provide additional hanger wires at each corner of recessed light troffers and other concentrated load conditions to prevent deflection in excess of 1/360th of span.
  - 2. Install cross tees at right angles to beam cross tees to support ends of light fixtures, diffusers or grilles and to form grid size indicated.

### **3.3 CLEANING**

- A. Clean to remove soil and stain.
- B. Remove and replace damaged units and units which cannot be cleaned.

**END OF SECTION**

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## SECTION 09 6116

### LIQUID FLOOR HARDENER

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required of this Section includes a penetrating liquid floor hardener and sealer applied to interior concrete surfaces along with supplementary items necessary to complete work required for their installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- B. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- C. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit to include in manual specified in Division 01 Section "Closeout Procedures". Include recommendations for periodic inspections, cleaning, care, maintenance, and repair of coatings.

##### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 2 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 2 years of experience installing products and systems similar to scope of this Project.

- C. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.6 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.7 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **1.8 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
1. Coverage of warranty includes but is not limited to the following: Degradation of dust proofing capabilities from abrasion.
  2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

### **2.2 LIQUID FLOOR HARDENER**

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Penetrating Liquid Floor Hardener and Sealer: Chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, densifies, and seals concrete surfaces.
  - 1. Manufacturers and Products:
    - a. Curecrete Distribution, Inc.; Ashford Formula
    - b. Euclid Chemical Company (The); Euco Diamond Hard
    - c. L&M Construction Chemicals, Inc.; Seal Hard

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer/fabricator's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

#### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

#### **3.4 INSTALLATION, LIQUID FLOOR HARDENER**

- A. Liquid Floor Hardener: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions including preparation, application, precautions, limitations, and compatibility with other surface conditions.
  - 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 seven days old unless recommended by manufacturer in written literature describing application procedure, but only with prior approval of Architect.
  - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
  - 4. Locations:
    - a. Exposed concrete floors in central energy plants.

- b. Mechanical rooms not receiving traffic coatings, electrical rooms, housekeeping, storage, and other similar service areas.
- c. Where indicated on room finish schedule or on drawings, including exposed concrete floors noted or scheduled as having "sealed concrete" or similar wording.

### **3.5 FIELD QUALITY CONTROL**

- A. **Manufacturer's Field Service:** Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. **Manufacturer's Technical Representative Qualifications:** Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.6 PROTECTION OF LIQUID FLOOR TREATMENTS**

- A. 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.

**END OF SECTION**

**SECTION 09 6500**  
**RESILIENT FLOORING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Resilient flooring products and systems and supplementary items necessary for installation.
- B. Related Section:
  - 1. Resilient wall base, reducer strips, and other accessories installed with resilient flooring are specified in Division 09 Section "Resilient Base and Accessories".

**1.2 ALLOWANCES**

- A. Concrete Moisture Barrier Allowance: Include allowance to provide Concrete Moisture Barrier Floor Treatment to concrete floor decks.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings for Special Patterns: Show layout and details of special patterns for resilient flooring.
- C. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- D. Samples for Verification Purposes: In manufacturer's standard size, but not less than 6 in by 9 in (150 mm by 230 mm) sample of each different color and pattern of resilient flooring product specified, showing the full range of variations expected in these characteristics. Label each sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules.
  - 1. Heat-Welded Sheet Flooring: For heat-welding bead, manufacturer's standard-size samples, but not less than 9 in (225 mm) long, of each color specified.
  - 2. Seam Samples for Sheet Flooring: For each color and pattern of resilient sheet flooring product required; with seam running lengthwise and in center of 6 in by 9 in (150 mm by 230 mm) sample applied to a rigid backing and prepared by installer for this Project.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

- B. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Instructions: Include in operation and maintenance manual as required by Division 01 Section "Closeout Procedures". Submit manufacturer's instructions for **maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.**

## **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
  - 1. Resilient Tile Flooring: Furnish not less than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of tile flooring product installed.
  - 2. Resilient Sheet Flooring: Furnish not less than 10 linear ft (3 linear m) in roll form and full roll width, for each 500 linear ft (150 linear m) or fraction thereof, of each color, pattern, and type of sheet flooring product installed.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Slip Resistance: Provide products identical to those tested for slip resistance per ASTM D 2047 with a static coefficient of friction not less than 0.6 for level surfaces and 0.8 for ramped surfaces.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: Class I, 0.45 W/sq. cm or greater when tested per ASTM E 648.
  - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Store flooring products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).
  - 1. Resilient Tile Flooring: Store floor tiles on flat surfaces.
  - 2. Resilient Sheet Flooring: Store sheet flooring rolls upright.



## **1.10 PROJECT CONDITIONS**

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C) in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless otherwise recommended by manufacturer.
- B. Maintain flooring products prior to installation at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended by manufacturer.
- D. Install flooring products after other finishing operations, including painting, have been completed.
- E. Do not install flooring over concrete substrates until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended tests. Refer to "Preparation" Article for requirements.

## **1.11 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

#### 1. Vinyl Flooring:

- a. Altro Group.
- b. Armstrong World Industries, Inc.
- c. Congoleum Corporation.
- d. Forbo Flooring, Inc.
- e. Gerflor, Architectural Floor Systems, Inc.
- f. Lonseal, Inc.
- g. Mannington Mills, Inc.
- h. Tarkett, Inc.

#### 2. Rubber Flooring

- a. AB; American Biltrite.
- b. Flexco.
- c. Nora Systems, inc.
- d. PRF USA, Inc.
- e. R.C.A. Rubber Company (The).
- f. VPI, LLC, Floor Products Division.

- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

- 1. Selections: As scheduled or as indicated in Interior Finish Legend on drawings.

## 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## 2.3 RESILIENT TILE FLOORING MATERIALS

- A. Vinyl Composition Floor Tile Standard: ASTM F 1066, Class 2, through-pattern tile, unless otherwise indicated.

- 1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).

- B. Solid Vinyl Floor Tile Standard: ASTM F 1700, Class 1, monolithic vinyl tile, unless otherwise indicated.

- 1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).

- C. Rubber Floor Tile: ASTM F 1344, Class I, unless otherwise indicated.

- 1. Size: 12 in by 12 in by 0.125 in (300 mm by 300 mm by 3 mm).

## 2.4 RESILIENT SHEET FLOORING MATERIALS

- A. Vinyl Sheet Floor Coverings: ASTM F 1303, Type I or II, Grade 1, Class A (fibrous) or B (nonfoamed plastic) backing or ASTM F 1913 unbacked as required by product selection.

- B. Rubber Sheet Floor Coverings: ASTM F 1859, Type I (homogeneous rubber sheet).

- C. Sheet Flooring Thickness: 0.125 in (3 mm).

- D. Heat-Welding Seam Bead: Solid-strand product of floor covering manufacturer for heat welding seams.

- 1. Selections: As scheduled or as indicated in Design Selections.

- E. Integral Cove Base Accessories: Resilient accessories recommended by flooring manufacturer with selections as follows:

- 1. Basis of Design: Burke Mercer Flooring Products; Division of Burke Industries, Inc.

- a. Cap Strip: No. 040 round vinyl cap.
    - b. Cove Strip: No. 070 flexible vinyl cove stick with nominal 1 in (25 mm) radius.
    - c. Reducer: No. 633 vinyl reducer, 1 in (25 mm) wide by 1/8 in (3 mm) high

## 2.5 ACCESSORY MATERIALS

- A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

- B. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by flooring manufacturer for products and applications indicated.
- C. Adhesives: Water-resistant type recommended by flooring manufacturer suitable for products, applications, and substrate conditions indicated.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Typical Flooring: Not more than 50 g/L.
    - b. Rubber Flooring: Not more than 60 g/L.
- D. Concrete Moisture Barrier Floor Treatment:
  - 1. Epoxy-Based Moisture Barrier Floor Treatment: Two-component, high-performance, non-flammable, rapid drying, water based, low odor, low VOC, two-component, penetrating epoxy; formulated to reduce moisture vapor transmission and surface alkalinity from concrete substrates, including aged or freshly placed ("green") concrete, prior to installation of impervious glued-down finish flooring specified in other Division 09 sections.
    - a. Basis of Design (Product Standard): Bostik, Inc.; D-250.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that concrete substrate finishes comply with requirements specified in Division 03 Section "Concrete Finishing" for concrete substrates receiving resilient flooring.

2. Verify that concrete substrates are free of cracks, ridges, depressions, scale, and foreign deposits.
  3. Verify that concrete substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Unless concrete has been water-cured, then proceed with the following:
    - a. Bead-blast concrete substrate with an apparatus that abrades the surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.
  4. Determine adhesion and dryness characteristics by performing the following tests as recommended by flooring manufacturer.
  5. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. A pH range of 5 to 9 is required when substrate is wetted with distilled water and pHydron paper is applied. Proceed with installation only after concrete substrates pass testing.
  6. Moisture Testing: Perform one or both of the following tests as recommended by flooring manufacturer. Perform 3 moisture tests for first 1000 sf (92.9 sm) of concrete substrate scheduled to receive flooring and 1 test for each additional 1000 sf (92.9 sm) or fraction thereof. Proceed with installation only after concrete substrates pass testing.
    - a. Perform anhydrous calcium chloride test in accordance with ASTM F 1869. Proceed with installation only after concrete substrates have maximum moisture-vapor-emission rate of 3 lbs of water/1000 sf (1.36 kg of water/92.9 sm) in 24 hours.
    - b. Perform relative humidity test using in situ probes in accordance with ASTM F 2170. Proceed with installation only after concrete substrates have a maximum 75 percent relative humidity level measurement.
  7. Moisture Barrier Floor Treatment: For concrete substrates not meeting moisture test standards specified above, apply epoxy-based moisture floor treatment and cementitious overcoat to concrete substrate in accordance with manufacturer's written instructions.
- C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
  - D. Broom and vacuum clean substrates to be covered immediately before flooring product installation. After cleaning, reexamine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.4 INSTALLATION OF RESILIENT FLOORING, GENERAL**

- A. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.
- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings. Extend flooring to center of door openings.

- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on substrate. Use chalk or other nonpermanent, non-staining marking device.
- E. Adhere flooring to substrates using a full spread of adhesive applied to substrate to comply with flooring manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
  - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- F. Hand-roll flooring in both directions from center out to embed flooring in adhesive and eliminate trapped air according to manufacturer's written instructions. At walls, door casings, and other locations where access by roller is impractical, press flooring firmly in place with flat-bladed instrument.

### **3.5 INSTALLATION OF RESILIENT TILE FLOORING**

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles square with room axis, unless otherwise indicated.
  - 2. Lay tiles with grain running in one direction, unless otherwise indicated.

### **3.6 INSTALLATION OF RESILIENT SHEET FLOORING**

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting, if recommended in writing by manufacturer.
- B. Lay out sheet flooring to comply with the following requirements:
  - 1. Maintain uniformity of sheet flooring direction.
  - 2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than **6 in (150 mm)** away from parallel joints in flooring substrates.
  - 3. Match edges of sheet flooring for color shading and pattern at seams according to manufacturer's written recommendations.
  - 4. Avoid cross seams.
- C. Integral Cove Base: Form integral cove base by flashing sheet flooring up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt flooring at top of base against cap strip.
- D. Heat-Welded Seams: Rout joints and heat weld with welding bead, permanently fusing sections into seamless flooring. Prepare, weld, and finish seams according to manufacturer's written instructions and ASTM F 1516 to produce surfaces flush with adjoining flooring surfaces.

- E. Chemically Bonded Seams: Chemically bond seams with bonding compound, permanently fusing sections into seamless flooring. Prepare seams and apply compound according to manufacturer's written instructions and ASTM F 693 to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.
- F. Access Flooring Panel Substrate: Install cement board substrate over access flooring panel substrate before installation of resilient flooring.

### **3.7 CLEANING AND PROTECTING**

- A. Perform the following operations immediately after installing flooring products:
  - 1. Remove adhesive and other surface blemishes from exposed surfaces using cleaner recommended by flooring manufacturer.
  - 2. Sweep or vacuum floor thoroughly.
  - 3. Do not wash floor until after time period recommended by flooring manufacturer.
  - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by flooring manufacturer.
  - 1. Cover products installed on floor surfaces with undyed, untreated building paper until just prior to Substantial Completion.
  - 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

### **3.8 RESILIENT FLOORING SCHEDULE**

- A. See Interior Finish Legend on drawings.

**END OF SECTION**

**SECTION 09 6513**

**RESILIENT BASE AND ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Resilient wall base, resilient flooring accessories, and supplementary items necessary for installation.

**1.2 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- C. Samples for Verification Purposes: In manufacturer's standard size, but not less than 12 in (300 mm) sample of each different color and pattern of resilient product specified, showing the **full range of variations expected in these characteristics.**

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: To include in maintenance manuals.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
  - 1. Furnish not less than 10 linear ft (3 linear m) for each 500 linear ft (150 linear m) or fraction thereof, of each different type, color, pattern, and size of resilient product installed.

**1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: Class I, 0.45 W/sq. cm or greater when tested per ASTM E 648.

2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

#### **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

#### **1.8 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 product manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

#### **1.9 PROJECT CONDITIONS**

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless otherwise recommended by product manufacturer.
- B. Maintain resilient products prior to installation at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during installation and for time period after installation recommended by manufacturer.
- D. Install resilient products after other finishing operations, including painting, have been completed.

#### **1.10 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  1. Armstrong World Industries, Inc.
  2. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
  3. Endura Rubber Flooring; Division of Burke Industries, Inc.
  4. Flexco, Inc.
  5. Johnsonite.
  6. Mondo Rubber International, Inc.
  7. Musson, R. C. Rubber Co.
  8. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
  9. Roppe Corporation, USA.



- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

1. Selections: As scheduled or as indicated in Interior Finish Legend on drawings.

## **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## **2.3 RESILIENT MATERIALS**

- A. Rubber Wall Base:

1. Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic), Group 1 and 2.
2. Thickness: Nominal 1/8 in (3 mm).
3. Lengths: Provide longest length(s) available per manufacturer. Provide coils if available in profile(s) indicated.
4. Outside and Inside Corners:
  - a. Job-formed.

- B. Resilient Molding Accessories:

1. Carpeting Accessories: Carpet cove cap, carpet step-off, carpet reducer, carpet edge bar.
2. Resilient Flooring Accessories: Reducer strip and others as required.
3. Material: Rubber.
4. Lengths: Provide longest length(s) available per manufacturer. Provide coils if available in profile(s) indicated.
5. Color and finish as selected by Architect from manufacturer's standard colors.

## **2.4 ACCESSORY MATERIALS**

- A. Adhesives: Water-resistant type recommended by product manufacturer suitable for products, applications, and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - a. Wall Base: Not more than 50 g/L.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF RESILIENT WALL BASE**

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- D. Do not stretch wall base during installation.
- E. Masonry Wall Surfaces: On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Job-Formed Corners: Use straight pieces of maximum lengths possible.
  - 1. Outside Corners: Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
  - 2. Inside Corners: Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

### **3.5 INSTALLATION OF RESILIENT FLOORING ACCESSORIES**

- A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

### **3.6 CLEANING AND PROTECTING**

- A. Perform the following operations immediately after installing resilient products:
  - 1. Remove adhesive and other surface blemishes from exposed surfaces using cleaner recommended by manufacturer.
  - 2. Sweep or vacuum horizontal surfaces thoroughly.

3. Do not wash resilient products until after time period recommended by manufacturer.
4. Damp-mop surfaces to remove marks and soil.

- B. Protect resilient products against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by resilient product manufacturer.

### **3.7 RESILIENT PRODUCT SCHEDULE**

- A. See Interior Finish Legend on drawings.

**END OF SECTION**

## SECTION 096566

### RESILIENT ATHLETIC FLOORING

#### 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. Interlocking, rubber floor tile.
- B. Related Requirements:
  - 1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

##### 1.3 COORDINATION

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details and locations of the following:
  - 1. Border tiles.
  - 2. Floor patterns.
  - 3. Layout, colors, widths, and dimensions of game lines and markers.
  - 4. Locations of floor inserts for athletic equipment installed through flooring.
  - 5. Seam locations for sheet flooring.
- C. Samples: For each exposed product and for each type, color, and pattern specified, [6-inch- (150-mm-)] <Insert dimension> square in size and of the same thickness indicated for the Work.

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RESILIENT  
ATHLETIC  
FLOORING

1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.
  2. Seam Samples: For each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of [6-by-9-inch (150-by-230-mm)] <Insert dimensions> Sample applied to a rigid backing and prepared by Installer for this Project.
- D. Samples for Initial Selection: For each type of resilient athletic flooring.
1. Game-Line and Marker Paint: Include charts showing available colors and glosses.
- E. Samples for Verification: For each type, color, and pattern of flooring specified, [6-inch (150-mm-)] <Insert dimension> square in size and of same thickness and material indicated for the Work.
1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For sheet vinyl flooring Installer.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

#### **1.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials[, from the same product run,] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Floor Tile: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of floor tile installed.

#### **1.8 QUALITY ASSURANCE**

- A. Sheet Vinyl Flooring Installer Qualifications: An experienced installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration.
  - 1. Store tiles on flat surfaces.

## **1.10 FIELD CONDITIONS**

- A. Install flooring after other finishing operations, including painting, have been completed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. PLITEQ
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
  - 1. Selections: GenieMat FIT70.
- C. Material: Recycled-rubber compound
- D. Color and Pattern: As selected by Architect from manufacturer's full range.
- E. Border: Interlocking tiles.
  - 1. Border Color and Pattern: Matching floor tile

### **2.2 ACCESSORIES**

- A. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, 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.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
  - 1. Do not install flooring until it is the same temperature as space where it is to be installed.
- F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.3 FLOORING INSTALLATION, GENERAL**

- A. Comply with manufacturer's written installation instructions.
- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

### **3.4 FLOOR TILE INSTALLATION**

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles in pattern indicated.
- B. Discard broken, cracked, chipped, or deformed tiles.
- C. Tile Matching: Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.
  - 1. Lay tiles in pattern of colors and sizes indicated.
- D. Adhered Floor Tile: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
  - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- E. Free-Lay Tile: Place flooring at locations indicated with units securely interconnected and fully seated on substrate to form a smooth, level surface.

### **3.5 GAME LINES AND MARKERS**

- A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.



- B. Apply game lines and markers in widths and colors according to requirements indicated on Drawings

### **3.6 CLEANING AND PROTECTION**

- A. Perform the following operations immediately after completing flooring installation:
  - 1. Remove adhesive and other blemishes from flooring surfaces.
  - 2. Sweep and vacuum flooring thoroughly.
  - 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
  - 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

**END OF SECTION**

## SECTION 09 6800

### CARPETING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Carpeting products and systems and supplementary items necessary for installation.
- B. Resilient wall base and resilient molding accessories installed with carpeting are specified in Division 09 Section "Resilient Base and Accessories".

##### 1.2 ALLOWANCES

- A. Concrete Moisture Barrier Allowance: Include allowance to provide Concrete Moisture Barrier Floor Treatment to concrete floor decks.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Provide floor plans, including columns, doorways, enclosing walls or partitions, built-in cabinets, and locations of cutouts, to indicate the following:
  - 1. Carpeting type and color.
  - 2. Type of substrate.
  - 3. Type of installation.
  - 4. Pattern type, location, and direction.
  - 5. Pile direction.
  - 6. Type, color, and location of insets and borders.
  - 7. Type, color, and location of edge, transition, and other accessory strips.
  - 8. Transition details to other flooring materials.
- C. Product Schedule: Use same designations indicated on the Finish Schedule and Drawings.
- D. Samples for Verification Purposes: In manufacturer's standard size, but not less than 6 in by 9 in (150 mm by 230 mm) sample of each different color, texture, and pattern of carpeting product specified, showing the full range of variations expected in these characteristics. Label each sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in Schedules.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.

- B. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required.
- C. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Instructions: Include in operation and maintenance manual as required by Division 01 Section "Closeout Procedures". Submit manufacturer's instructions for maintenance of installed work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning materials and methods which may be detrimental to finishes and performance.

### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Materials: Furnish the following extra materials that match and are from same production runs as products installed, packaged with protective covering for storage and identified with labels describing contents:
  - 1. Tile Carpeting: Furnish full-size units of tile carpeting equal to 5 percent of amount installed for each color and type indicated, but not less than 10 sq yd (8.4 sq m).

### **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: Class I, 0.45 W/sq. cm or greater when tested per ASTM E 648.
  - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

### **1.8 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. General: Comply with CRI 104, Section 5, "Storage and Handling".

### **1.10 PROJECT CONDITIONS**

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity".
- B. Environmental Limitations: Do not install carpeting until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- C. Maintain carpeting products prior to installation at the same temperature as the space where they are to be installed.
- D. Close spaces to traffic during carpeting installation and for time period after installation recommended by manufacturer.
- E. Install carpeting products after other finishing operations, including painting, have been completed.
- F. Do not install carpeting over concrete substrates until slabs have cured and are sufficiently dry to bond with adhesive, as determined by carpeting manufacturer's recommended tests. Refer to "Preparation" Article for requirements.

#### **1.11 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

#### **1.12 WARRANTY**

- A. Manufacturer's Warranty for Carpeting: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  1. Coverage of warranty includes but is not limited to more than 10 percent edge raveling, snags, runs, dimensional stability, loss of tuft bind strength, loss of face fiber, and delamination.
  2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion.
- B. Warranty does not include deterioration or failure of carpeting due to unusual traffic, failure of substrate, vandalism, or abuse.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

#### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

- B. Emissions: Provide carpet that complies with testing and product requirements of CRI's "Green Label Plus" program.

### **2.3 TILE CARPETING**

- A. Basis of Design (Product Standard):
  - 1. Selections: As scheduled or as indicated in Interior Finish Legend on drawings.

### **2.4 ACCESSORY MATERIALS**

- A. Concrete Slab Primer: Non-staining type as recommended by carpeting manufacturer.
- B. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpeting manufacturer.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpeting and is recommended or provided by carpeting manufacturer.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Not more than 50 g/L.
- D. Concrete Moisture Barrier Floor Treatment:
  - 1. Epoxy-Based Moisture Barrier Floor Treatment: Two-component, high-performance, non-flammable, rapid drying, water based, low odor, low VOC, two-component, penetrating epoxy; formulated to reduce moisture vapor transmission and surface alkalinity from concrete substrates, including aged or freshly placed ("green") concrete, prior to installation of impervious glued-down finish flooring specified in other Division 09 sections.
    - a. Basis of Design (Product Standard): Bostik, Inc.; D-250.
  - 2. Cementitious Overcoat: Fast-setting latex-fortified Portland cement skim coating intended for interior uses.
    - a. Basis of Design (Product Standard): Bostik, Inc.; Webcrete 95.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation" and carpeting manufacturer's written installation instructions for preparing substrates indicated to receive carpeting installation.
- C. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that concrete substrate finishes comply with requirements specified in Division 03 Section "Concrete Finishing" for concrete substrates receiving carpeting.
  - 2. Verify that concrete substrates are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 3. Verify that concrete substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Unless concrete has been water-cured, then proceed with the following:
    - a. Shot-blast concrete substrate with an apparatus that abrades the surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    - b. Repair damaged and deteriorated concrete according to flooring manufacturer's written recommendations.
  - 4. Determine adhesion and dryness characteristics by performing the following tests as recommended by flooring manufacturer.
  - 5. Alkalinity and Adhesion Testing: Perform tests recommended by flooring manufacturer. A pH range of 5 to 9 is required when substrate is wetted with distilled water and pHydriion paper is applied. Proceed with installation only after concrete substrates pass testing.
  - 6. Moisture Testing: Perform one or both of the following tests as recommended by flooring manufacturer. Perform 3 moisture tests for first 1000 sf (92.9 sm) of concrete substrate scheduled to receive flooring and 1 test for each additional 1000 sf (92.9 sm) or fraction thereof. Proceed with installation only after concrete substrates pass testing.
    - a. Perform anhydrous calcium chloride test in accordance with ASTM F 1869. Proceed with installation only after concrete substrates have maximum moisture-vapor-emission rate of 3 lbs of water/1000 sf (1.36 kg of water/92.9 sm) in 24 hours.
    - b. Perform relative humidity test using in situ probes in accordance with ASTM F 2170. Proceed with installation only after concrete substrates have a maximum 75 percent relative humidity level measurement.

7. Moisture Barrier Floor Treatment: For concrete substrates not meeting moisture test standards specified above, apply epoxy-based moisture barrier treatment and cementitious overcoat to concrete substrate in accordance with manufacturer's written instructions.

D. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

E. Broom and vacuum clean substrates to be covered immediately before installing carpeting. After cleaning, reexamine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.4 INSTALLATION OF CARPETING**

A. Scribe, cut, and fit carpeting to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

B. Extend carpeting into toe spaces, door reveals, closets, and similar openings. Extend carpeting to center of door openings.

C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish carpeting as marked on substrate. Use chalk or other nonpermanent, non-staining marking device.

D. Do not bridge building expansion joints with carpet.

E. Bind or seal cut edges as recommended by carpeting manufacturer.

F. Install pattern parallel to walls and borders unless otherwise indicated.

G. Hand-roll carpeting in both directions from center out to embed carpeting in adhesive and eliminate trapped air according to manufacturer's written instructions. At walls, door casings, and other locations where access by roller is impractical, press carpeting firmly in place with flat-bladed instrument.

### **3.5 INSTALLATION OF TILE CARPETING**

A. Tile Carpet at Concrete Substrates: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)" and carpet manufacturer's written recommendations for full glue-down installation of every tile with releasable adhesive.

B. Install pattern parallel to walls and borders unless otherwise indicated.

### **3.6 INSTALLATION OF ADHERED SHEET CARPETING**

A. Apply concrete slab primer, if recommended by carpeting manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

B. Adhere to concrete substrates using a full spread of adhesive applied to substrate to comply with carpeting manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

- C. Comply with carpeting manufacturer's written recommendations for seam locations and direction of carpeting; maintain uniformity of carpeting direction and lay of pile. At doorways, center seams under the door in closed position.

### **3.7 CLEANING AND PROTECTION**

- A. Perform the following operations immediately after installing carpeting:
  - 1. Remove excess adhesive and other surface blemishes from exposed surfaces using cleaner recommended by carpeting manufacturer.
  - 2. Remove yarns that protrude from carpeting surface.
  - 3. Vacuum carpeting using commercial machine with face-beater element.
- B. Protect installed carpeting to comply with CRI 104, Section 16, "Protecting Indoor Installations".
- C. Protect carpeting against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpeting manufacturer.

### **3.8 CARPETING SCHEDULE**

- A. Selections: As shown in interior Finish Legend on drawings.

**END OF SECTION**





## SECTION 09 9100

### PAINTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Surface preparation and field painting of exposed interior items, exterior items and surfaces.
1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where indicated that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
1. Painting includes field painting of exposed bare and covered pipes and ducts, hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels, unless indicated otherwise.
1. Prefinished items include the following factory-finished components:
    - a. Prefinished wood doors.
    - b. Acoustical materials.
    - c. Prefinished Architectural woodwork and cabinets.
    - d. Elevator equipment.
    - e. Finished mechanical and electrical equipment.
    - f. Light fixtures.
    - g. Distribution cabinets.
    - h. Baked enamel coated items.
    - i. Fluorocarbon coated items.
    - j. Integral colored plaster.
    - k. Integral colored PVC.
  2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Foundation spaces.
    - b. Furred areas.
    - c. Ceiling plenums.
    - d. Utility tunnels.
    - e. Pipe spaces.
    - f. Duct shafts.
    - g. Elevator shafts.

3. Finished metal surfaces include the following:
    - a. Anodized aluminum.
    - b. Stainless steel.
    - c. Chromium plate.
    - d. Copper and copper alloys.
    - e. Bronze and brass.
  4. Operating parts include moving parts of operating equipment and the following:
    - a. Valve and damper operators.
    - b. Linkages.
    - c. Sensing devices.
    - d. Motor and fan shafts.
  5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
    - a. Embossed UL labels may be used and painted where acceptable to authority having jurisdiction
- D. Related Sections:
1. Division 09 Section "Gypsum Board Assemblies" for surface preparation of gypsum board assemblies.

## 1.2 DEFINITIONS

- A. MPI Gloss Levels: MPI Gloss and Sheen Standard values are measured per ASTM D523, Method D and are as follows:
1. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees.
  2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
  3. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
  4. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
  5. Gloss Level 5: 35 to 70 units at 60 degrees.
  6. Gloss Level 6: 70 to 85 units at 60 degrees.
  7. Gloss Level 7: More than 85 units at 60 degrees.
- B. Exterior Painting: Generally includes surfaces located in unconditioned spaces.
- C. Interior Painting: Generally includes surfaces located in conditioned spaces.

## 1.3 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
1. Include manufacturer's specifications for materials, finishes, installation instructions, and recommendations for maintenance.
- B. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
1. Submit Samples on rigid backing, 8 in (200 mm) square.
  2. Step coats on Samples to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Manufacturers Project Acceptance Document: Certification that products are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that warranty will be issued.
1. Certifications by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### **1.6 QUALITY ASSURANCE**

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" and "MPI Maintenance Repainting Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples 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. Install mockup in the location and of the size indicated or, if not indicated, as directed by Architect.
    - a. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      - 1) Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      - 2) Other Items: Architect will designate items or areas required.
      - 3) Demonstrate repair procedures for damaged surfaces.

- b. Apply samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
  - c. Final approval of color selections will be based on benchmark samples.
    - 1) If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.
2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

## **1.9 PROJECT CONDITIONS**

- A. Apply paints only when temperatures of surfaces to be painted and surrounding air are between minimum and maximum range recommended by manufacturer.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

## **1.10 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  1. Behr.

2. Benjamin Moore & Co.
3. Dunn-Edwards Corporation.
4. Kelly-Moore Paints.
5. PPG Paints.
6. Pratt & Lambert Paints.
7. Sherwin-Williams Company (The).

B. Color and Gloss: As scheduled or as indicated in Interior Finish Legend on drawings.

## **2.2 PAINT, GENERAL**

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Source Limitations: Obtain block fillers and field applied primers for each coating system from the same manufacturer as the finish coats.
- C. 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 manufacturers of topcoat for use in paint system and on substrate indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to shop applicators to ensure use of compatible primers.

### **3.2 INSTALLATION**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform work according to the following, unless otherwise specified in this Section:
1. Respective manufacturer's written installation instructions.
  2. Approved submittals.
  3. Contract Documents.
  4. MPI Architectural Painting Specification Manual" or "MPI Maintenance Repainting Manual", as applicable.

### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" and "MPI Maintenance Repainting Manual" applicable to substrates and paint systems indicated.
- C. Remove plates, machined surfaces, and similar items already in place that 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.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates, unless expressly permitted by authorities having jurisdiction for labels intended to be painted.
- D. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
  - 1. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
  - 1. Galvanized metal substrates shall not be chromate passivated. If galvanized metal is chromate passivated, provide surface preparation and primers recommended by manufacturer.
- G. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
- I. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

- J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### **3.4 APPLICATION**

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items, equipment, and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items, 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. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
  - 5. The number of coats and film thickness required are the same regardless of application method.
  - 6. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  - 7. Omit primer over metal surfaces that have been shop primed and touchup painted.
  - 8. Allow sufficient time between successive coats to permit proper drying.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Tint per manufacturer's technical data for each type of primer or undercoat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve total dry film thickness of the entire system as recommended by manufacturer.

### **3.5 MECHANICAL AND ELECTRICAL WORK PAINTING AND IDENTIFICATION**

- A. Painting of Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work to be done when exposed in the following locations:
  - 1. Equipment Rooms.
  - 2. Occupied Spaces.
  - 3. Exterior Walls.
  - 4. Roof Areas.
- B. Equipment includes, but is not limited to, the following:
  - 1. Uninsulated piping.
  - 2. Pipe hangers and supports.
  - 3. Tanks that do not have factory-applied final finishes.
  - 4. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.



- 5. Equipment that is indicated to have a factory-primed finish for field painting.
- C. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces. Paint with a flat, nonspecular black paint.
- D. Pipe Identification: Conform to requirements of ANSI/ASME A13.1 "Scheme for the Identification of Piping Systems".

### **3.6 FIRE AND SMOKE BARRIER IDENTIFICATION**

- A. Fire and smoke resistant rated walls shall be effectively and permanently identified with signs, labels or stencils in a manner acceptable to authority having jurisdiction.
  - 1. Identification shall be above decorative ceiling and in concealed spaces, on each segment of the wall and 6'-0" O.C. maximum on each side of wall.

### **3.7 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. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces to match approved samples.

### **3.8 EXTERIOR PAINTING SCHEDULE**

- A. Concrete Substrates, Nontraffic Surfaces:
  - 1. Latex Over Alkali-Resistant Primer System: MPI EXT 3.1A.
    - a. Prime Coat: Primer, alkali resistant, water based, MPI #3; VOC 100 g/L max.
    - b. Intermediate Coat: Exterior latex matching topcoat.
    - c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10; VOC 50 g/L max.
    - d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15; VOC 100 g/L max.
    - e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11; VOC 100 g/L max.
    - f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119; VOC 100 g/L max.
- B. CMU Substrates:
  - 1. Latex System: MPI EXT 4.2A.
    - a. Prime Coat: Block filler, latex, interior/exterior, MPI #4; VOC 100g/L max.

- b. Intermediate Coat: Exterior latex matching topcoat.
- c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10; VOC 50 g/L max.
- d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15; VOC 100 g/L max.
- e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11; VOC 100 g/L max.
- f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119; VOC 100 g/L max.
- g. Gloss and Sheen: As scheduled or as indicated in Design Selections.

C. Stucco (Portland Cement Plaster) Substrates:

- 1. Latex over Alkali-Resistant, Water-Based Primer System: MPI EXT 9.1J.
  - a. Prime Coat: Primer, alkali resistant, water based, MPI #3; VOC 100 g/L max.
  - b. Intermediate Coat: Exterior latex matching topcoat.
  - c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10; VOC 50 g/L max.
  - d. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15; VOC 100 g/L max.
  - e. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11; VOC 100 g/L max.
  - f. Topcoat: Latex, exterior, gloss (MPI Gloss Level 6), MPI #119; VOC 100 g/L max.
  - g. Gloss and Sheen: As scheduled or as indicated in Design Selections.

D. Steel Substrates (Ferrous Metal):

- 1. Water-Based, Light-Industrial Coating System: MPI EXT 5.1M
  - a. Prime Coat: Rust-inhibitive primer, (water based), primer, MPI #107, VOC 100 g/L max.
  - b. Intermediate Coat: Water-based, light-industrial coating, matching topcoat.
  - c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161, VOC 100 g/L max.
  - d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163, VOC 100 g/L max.
  - e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164, VOC 100 g/L max.
  - f. Gloss and Sheen: As scheduled or as indicated in Design Selections.

E. Galvanized-Metal Substrates:

- 1. Water-Based, Light-Industrial Coating System: MPI EXT 5.3J.
  - a. Prime Coat: Waterborne galvanized-metal primer, MPI #134, VOC 100 g/L max.
  - b. Intermediate Coat: Water-based, light-industrial coating, matching topcoat.
  - c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161, VOC 100 g/L max.
  - d. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163, VOC 100 g/L max.
  - e. Topcoat: Light industrial coating, exterior, water based, gloss (MPI Gloss Level 6), MPI #164, VOC 100 g/L max.
  - f. Gloss and Sheen: As scheduled or as indicated in Design Selections.

### 3.9 INTERIOR PAINTING SCHEDULE

#### A. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
  - a. Prime Coat: Rust-inhibitive primer (water based), MPI #107, VOC 100 g/L max.
  - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143, VOC 10 g/L max.
  - d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144, VOC 10 g/L max.
  - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145, VOC 10 g/L max.
  - f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146, VOC 10 g/L max.
  - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147, VOC 10 g/L max.
  - h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148, VOC 10 g/L max.
  - i. Gloss and Sheen: As scheduled or as indicated in Design Selections.

#### B. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.
  - a. Prime Coat: Waterborne galvanized-metal primer, MPI #134, VOC 100 g/l max.
  - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143, VOC 10 g/l max.
  - d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144, VOC 10 g/L max.
  - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145, VOC 10 g/L max.
  - f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146, VOC 10 g/L max.
  - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147, VOC 10 g/l max.
  - h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148, VOC 10 g/l max.
  - i. Gloss and Sheen: As scheduled or as indicated in Design Selections.

#### C. Wood Panel Substrates: Including painted plywood, medium-density fiberboard, hardboard.

1. Institutional Low-Odor/VOC Latex System: MPI INT 6.4T.
  - a. Prime Coat: Interior latex-based wood primer, MPI #39, VOC 100 g/L max.
  - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143, VOC 10 g/L max.
  - d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144, VOC 10 g/L max.
  - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145, VOC 10 g/L max.

- f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146, VOC 10 g/L max.
- g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147, VOC 10 g/L max.
- h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148, VOC 10 g/L max.
- i. Gloss and Sheen: As scheduled or as indicated in Design Selections.

D. Gypsum Board and Plaster (Gypsum and Portland Cement) Substrates:

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
  - a. Prime Coat: Institutional low-odor/VOC primer/sealer, MPI 149, VOC 10 g/L max.
  - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143, VOC 10 g/L max.
  - d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144, VOC 10 g/L max.
  - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145, VOC 10 g/L max.
  - f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146, VOC 10 g/L max.
  - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147, VOC 10 g/L max.
  - h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148, VOC 10 g/L max.
  - i. Gloss and Sheen: As scheduled or as indicated in Design Selections.
  - j. Gloss and Sheen: As scheduled or as indicated in Design Selections.

E. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 10.1D.
  - a. Prime Coat: Institutional low-odor/VOC primer/sealer, MPI #50, VOC 100 g/L max.
  - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
  - c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143, VOC 10 g/L max.
  - d. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 2), MPI #144, VOC 10 g/L max.
  - e. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145, VOC 10 g/L max.
  - f. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 4), MPI #146, VOC 10 g/L max.
  - g. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147, VOC 10 g/L max.
  - h. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148, VOC 10 g/L max.
  - i. Gloss and Sheen: As scheduled or as indicated in Design Selections.

### 3.10 PAINTING FINISH SCHEDULE

- A. See Interior Finish Legend on drawings.

**END OF SECTION**

## SECTION 10 1400

### INTERIOR SIGNAGE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required for this section includes code required signs, including ADA, and supplementary items necessary to complete their installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, mounting heights, spacing, reinforcement, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Provide message list for each sign, including large-scale details of wording, lettering, and Braille layout.
- C. Samples for Initial Selection: For each type of sign material indicated that involves color selection.
- D. Samples for Verification: For each type of sign, include the following Samples to verify color selected:
  - 1. Panel Signs: Full-size Samples of each type of sign required.
  - 2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter and number) required. Show character style, material, finish, and method of attachment.
  - 3. Approved samples will not be returned for installation into Project.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

##### 1.4 QUALITY ASSURANCE

- A. Manufacturer/Fabricator Qualifications: Manufacturer with experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Regulatory Requirements: Comply with code provisions as adopted by authorities having jurisdiction and with Americans with Disabilities Act (ADA) for the following:
  - 1. Tactile and Braille Characters.

2. Typestyles.
3. Character Height.
4. Pictograms (Symbols).
5. Finish and Contrast.
6. Mounting Location and Height.

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

1. ASI Sign Systems, Inc.
2. Best Manufacturing Company.
3. Mohawk Sign Systems.
4. Seton Identification Products
5. The Supersine Company.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 MATERIALS**

- A. Plastic Laminate: Provide melamine plastic laminate engraving stock with face and core plies in contrasting colors.
- B. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F.
1. Colored Coatings: Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.
  2. Mounting Fasteners: Use concealed fasteners fabricated from materials that are not corrosive to the sign material and mounting surface.

### **2.4 FABRICATION**

- A. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished with square coat edge condition and square corner condition.
- B. Graphic Content and Style: Provide sign copy that complies with requirements indicated and ADA for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.

- C. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.
- D. Typical Sign Design:
- E. Material: Cast-acrylic sheet or Plastic laminate.
- F. Perimeter: Unframed.
- G. Copy: Tactile and Braille.
- H. Character Style: Helvetica.
- I. Text: As indicated in the Sign Schedule to identify location.
- J. Message: Fixed.
- K. Sizes: Minimum required to meet code and ADA requirements.
- L. Colors: As selected from manufacturer's standard colors.

## **2.5 FINISHES**

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Respective manufacturer written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.



### 3.3 PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### 3.4 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
  - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
  - 2. Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 in (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using one method indicated below:
  - 1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
  - 2. Hook-and-Loop Tapes: Use hook-and-loop tapes to mount signs to smooth, nonporous surfaces.
  - 3. Magnetic Tape: Use magnetic tape to mount signs to smooth, nonporous surfaces.
  - 4. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.

### 3.5 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

### 3.6 SCHEDULE OF SIGNS

- A. See drawings for plan locations, schedules, and elevations.
- B. Stairs:
  - 1. Provide a sign at each door to each stairway on each floor.
  - 2. Message:
    - a. Required wording for exiting as required by the local code authorities. **“STAIR WAY”**.
    - b. Braille message as required by ADA.
- C. Stairs To Roof:
  - 1. Provide a sign at each door on Level One to each stairway that goes to Roof.
  - 2. Message: Required wording as required by the local code authorities. **“STAIRS GOES TO ROOF”**.

D. Inside Stairs:

1. Provide a sign at each door in stairways.
2. Message: As required by local code authorities.
  - a. Identify stair location.
  - b. Identify floor level.
  - c. Identify all floors served.
  - d. Identify stairway's upper terminus.
3. Braille message as required by ADA.

E. Elevator Lobbies:

1. Provide a sign at each elevator group on other than Level One.
2. Provide a sign at each elevator group on all levels.
  - a. Message:
    - 1) Required wording and diagram for exiting as required by the local code authorities.  
"IN CASE OF FIRE  
DO NOT USE ELEVATORS  
USE STAIRS"
    - 2) Graphic symbols that are appropriate, including Fire Evacuation Map.
    - 3) Braille message as required by ADA.
  - b. Mount above elevator call button.

F. Toilet Rooms:

1. Provide a sign at the door to each public toilet room.
2. Message:
  - a. "MEN" or "WOMEN" as appropriate for the room.
  - b. Graphic symbol that is appropriate for the room.
  - c. Symbol of accessibility.
  - d. Braille message as required by ADA.

G. Other Rooms:

1. Provide a sign at each door that leads into the following rooms:
2. **TELEPHONE ROOM**
3. **ELECTRICAL ROOM**
4. **JANITOR CLOSET**
5. **MECHANICAL ROOM**
6. **MAIN TELEPHONE ROOM**
7. **MAIN ELECTRICAL ROOM**
8. **FIRE PUMP ROOM**
9. **FIRE CONTROL ROOM**
10. **SERVICE ELEVATOR**
11. **ELEVATOR MACHINE ROOM**
12. Braille message as required by ADA.

**END OF SECTION**

## SECTION 10 2113

### TOILET COMPARTMENTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work for this section includes standard, manufactured toilet compartments and supplementary items necessary to complete work required for their installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.
- B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of reinforcement and cutouts for compartment-mounted toilet accessories.
- C. Samples for Verification: Of each compartment or screen color and finish required, prepared on 6-inch- (150-mm-) square Samples of same thickness and material indicated for Work.

##### 1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" for toilet compartments designated as accessible.

##### 1.4 PROJECT CONDITIONS

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
1. Stainless Steel Units:
    - a. Accurate Partitions Corporation.
    - b. All American Metal Corp.
    - c. American Sanitary Partition Corporation.
    - d. Ampco, Inc.
    - e. Bradley Corporation; Mills Partitions.
    - f. Flush Metal Partition Corp.
    - g. General Partitions Mfg. Corp.
    - h. Global Steel Products Corp.
    - i. Hadrian Manufacturing Inc.
    - j. Knickerbocker Partition Corporation.
    - k. Metpar Corp.
    - l. Sanymetal; a Crane Plumbing company.

### **2.2 MATERIALS**

- A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.
- B. Stainless-Steel Sheet: ASTM A 666, Type 302 or 304, that is leveled to stretcher-leveled flatness, finished on exposed faces as indicated in the "Stainless-Steel Sheet Finishes" Article, and of the following minimum thicknesses:
1. Pilasters:
    - a. Overhead Braced Units: 0.0375 in (0.9 mm).
    - b. Unbraced Units: 0.0500 in (1.25 mm).
  2. Panels and Screens: 0.0375 in (0.9 mm).
  3. Doors: 0.0312 in (0.78 mm).
  4. Tapping Reinforcement: 0.0781 in (1.9 mm).
- C. Core Material for Metal-Faced Units: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 in (25 mm) minimum for doors, panels, and screens and 1-1/4 in (32 mm) minimum for pilasters.
- D. Pilaster Shoes and Sleeves (Caps): ASTM A 666, Type 302 or 304 stainless steel, not less than 0.0312 in (0.78 mm) thick and 3 in (75 mm) high, finished to match hardware.
- E. Stirrup Brackets: Manufacturer's standard Chrome-plated, nonferrous, case zinc alloy (zamac) or clear-anodized aluminum ear or U-brackets for attaching panels to walls and pilasters.

- F. Hardware and Accessories: Manufacturer's standard design, heavy-duty Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear-anodized aluminum operating hardware and accessories.
- G. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.
  - 1. Floor Mounted Units: Anchorages and fasteners in contact with or in close proximity to floor shall be stainless steel

## **2.3 FABRICATION**

- A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars.
- B. Metal-Faced Toilet Compartments and Screens: Pressure laminate seamless face sheets to core material and provide continuous, interlocking molding strip or lapped and formed edges. Seal corners by welding or clips. Grind exposed welds smooth. Provide internal reinforcement for compartment-mounted hardware, accessories, and grab bars, as indicated.
- C. Floor-Anchored Compartments: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- D. Floor-Anchored Screens: Provide pilasters and panels of same construction and finish as toilet compartments. Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
- E. Doors: Unless otherwise indicated, provide 30 in (750 mm) wide clear opening in-swinging doors for standard toilet compartments and 36 in (900 mm) wide out-swinging doors with a minimum 32 in (800 mm) wide clear opening for compartments indicated to be accessible.
  - 1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold door open at any angle up to 90 degrees.
  - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible.
  - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
  - 4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at out-swinging doors.
  - 5. Door Pull: Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be accessible.

## **2.4 STAINLESS-STEEL SHEET FINISHES**

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
  - 1. Remove or blend tool and die marks and stretch lines into finish.

2. Grind and polish surfaces to produce uniform, directional textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Finish: No. 4 bright, directional polish.
  - C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Respective manufacturer's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.

### **3.3 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 in (12 mm) between pilasters and panels and not more than 1 in (25 mm) between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.
  1. Secure panels to walls and panels with not less than 2 stirrup brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.
- B. Floor-Anchored Compartments: Set pilaster units with anchors penetrating not less than 2 in (50 mm) into structural floor, unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
- C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

**3.4 ADJUSTING AND CLEANING**

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.
- B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

**3.5 FINISH SCHEDULE:** As per Interior Finish Legend.

**END OF SECTION**





**SECTION 10 2115**  
**CUBICLE SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Work required for this section includes cubicle specialties and supplementary items necessary to complete their installation.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's specifications to evidence compliance with these specifications.
- B. Shop Drawings:
  - 1. Show details of the system, related construction and reflected layout of ceiling areas showing location of tracks in relation to other ceiling mounted items.
  - 2. Indicate materials, finishes, dimensions, thicknesses and/or gages of parts, reinforcement, where applicable, and anchorage including items of hardware and accessories necessary for complete installation.
- C. Samples for Verification: Full-size units of each type of the following products:
  - 1. Curtain Fabric: 12 in (300 mm) square swatch or larger Sample as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
  - 2. Curtain Track: Not less than 4 in (100 mm) long.
  - 3. Curtain Carrier: Full-size unit.
  - 4. IV Track: Not less than 4 in (100 mm) long.
  - 5. IV Hanger: Full-size unit.
- D. Cubicle Schedule: Use same room designations as indicated on Drawings.

**1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each product if specified to include in maintenance manuals specified in Division 01.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of quantity installed for each size indicated, but not less than 10 units.
  - 2. Curtains: Full-size units equal to 10 percent of quantity installed, but not less than 2 units.

## 1.5 QUALITY ASSURANCE

- A. Mockup: Build mockup to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution.
  - 1. Build mockup of typical cubicle, complete with tracks, IV hanger, and curtain if specified.
  - 2. Approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install cubicle specialties until spaces are enclosed and weatherproof, 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.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  - 1. C/S Cubicle Curtains.
  - 2. Imperial Fastener Company, Inc.
  - 3. InPro Corporation.
  - 4. A. R. Nelson Co.
  - 5. Salisbury Industries.

### 2.2 CURTAIN TRACKS

- A. Extruded-Aluminum Track: Not less than 1-1/4 inches wide by 3/4 inch high, with minimum wall thickness of 0.058 inch.
  - 1. Curved Track: Factory fabricated 12-inch-radius bends.
  - 2. Finish: Baked enamel, acrylic, or epoxy, white color.
- B. 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.
- C. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel, stainless steel, or aluminum hook with nickel plated steel beaded chain curtain drop.
- D. Breakaway Curtain Carriers (Detention/Psychiatric): One-piece nylon breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than 22 lbf (98 N).
- E. Exposed Fasteners: Stainless steel.

- F. Concealed Fasteners: Hot-dip galvanized.

## **2.3 CURTAINS**

- A. Cubicle Curtain Fabric: Cubicle manufacturer's standard, as follows:
  - 1. Color: As selected by Architect from manufacturer's full range.
  - 2. Fiber Content: 100 percent polyester, inherently and permanently flame resistant.
- B. Cubicle Curtain Fabric: Subject to compliance with requirements, provide the following:
  - 1. Refer to Division 01 Section "Interior Design Selections":
- C. Shower Curtain Fabric: Subject to compliance with requirements, provide the following:
  - 1. Refer to Design Selections.
  - 2. Refer to Division 10 Section "Toilet Accessories".
- D. Mesh Top: No. 50 (1/2 inch) nylon mesh. Top 20 in (500 mm) of curtain.
  - 1. Color: As selected by Architect from manufacturer's full range.
- E. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 in (150 mm) o.c.; machined into top hem.
- F. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.
- G. Fabrication: Fabricate curtains to comply with the following requirements:
  - 1. Width: Finished width of panel to be 3 in (75 mm) less than specified fabric width.
  - 2. Length: Equal to floor-to-ceiling height minus depth of track and carrier at top, and minus 15 inch distance above finished floor at bottom.
  - 3. Mesh Top: Top hem not less than 1 in (25 mm) and not more than 1-1/2 in (38 mm) wide, triple thickness, reinforced with integral web, and double lock stitched. Double lock stitch bottom of mesh directly to 1/2 in (12 mm) triple thickness, top hem of curtain fabric.
  - 4. Bottom Hem: Not less than 1 inch and not more than 1-1/2 in (38 mm) wide, double thickness and double lock stitched.
  - 5. Side Hems: Not less than 1 in (25 mm) and not more than 1-1/2 in (38 mm) wide, with double thickness and double lock stitch.
  - 6. Vertical Seams: Not less than 1/2 in (12 mm) wide, double turned and double stitched.
  - 7. Top Hem: Triple thickness with edges turned and stitched top and bottom.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. General: Install tracks level and plumb, according to manufacturer's written instructions. Provide track fabricated from one continuous length up to 16 feet.
  - 1. Track Mounting:
    - a. Ceilings Heights 9'-0" and Less: Surface.
    - b. Ceilings Heights Greater than 9'-0": Suspended.
- B. Surface Track Mounting: Fasten surface-mounted tracks at intervals of not less than 24 in (600 mm). Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Mechanically fasten to suspended ceiling grid with screws.
- C. Suspended Track Mounting for High Ceilings: At ceiling heights greater than 9'-0" Install track with suspended supports at intervals of not more than 48 in (1200 mm). Fasten support at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.
- 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. IV Hangers: Unless otherwise indicated, install one IV hook on each IV track and hang one IV hanger.
- F. Curtain Carriers: Provide curtain carriers adequate for 6 in (150 mm) spacing along the full length of the curtain plus an additional carrier.
- G. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.
  - 1. Install number of curtain panel units necessary for length of track to ensure that the total length is not less than 10 percent longer than length of track.
  - 2. Top corners of each curtain panel is to share one curtain carrier so that when leading curtain panel is pulled, then all panels are interlocked and move as one continuous curtain.

**END OF SECTION**

## SECTION 10 2238

### OPERABLE PANEL PARTITIONS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required for this section includes operable panel partitions and supplementary items necessary to complete their installation.
  - 1. Operable partitions shall be furnished as shown on the drawings complete with track, jambs, hardware as required for attaching track and jambs to the building structure, and supplementary items required to provide a complete and properly functioning installation. Exact construction details shall provide specified acoustical and functional performance.
- B. Independent Testing Laboratory: This Section specifies testing and coordination for testing by Independent Testing Laboratory employed by Contractor and accepted by Architect.
  - 1. Cost of Testing Laboratory Services shall be paid for by Contractor.
  - 2. In event that system failures necessitate retesting, Contractor shall pay additional Testing Laboratory Service fees and any fees and expenses incurred by Owner and Architects as result of retesting.
  - 3. Contractor shall be liable for any failure of the work to meet test requirements without adjustment to Contract Sum or Contract Schedule.

##### 1.2 DELEGATED ENGINEERING REQUIREMENTS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required. Contract Documents shall not be construed as an engineered design; furnish and install all Work required for a complete installation.
- B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer.
- C. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- D. Coordination of Work:

1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

### **1.3 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  2. Include data on acoustical performance, surface-burning characteristics, and durability.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  1. Show location and extent of operable panel partitions. Include plans, elevations, sections, details, numbered panel installation sequence, attachments to other construction, and accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, and direction of travel.
    - a. Calculate requirements for supporting operable panel partitions and verify capacity of carriers and track components to support loads; indicate deflection limits for partition and adjacent construction.
  2. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  1. Suspended ceiling components.
  2. Structural members to which suspension systems will be attached.
  3. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Access panels.
  4. Plenum fire and acoustical barriers.

- D. Setting Drawings: For embedded items and cutouts required in other work, including support beam punching template.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color, pattern or texture variations, include sample sets showing the full range of variations expected.
  - 1. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
  - 2. Panel Edge Material: Not less than full width by 6 inches (150 mm) long.
  - 3. Hardware: Mechanically operated bottom seal operating device.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the approved qualified engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- B. Product Test Reports: Written reports based on evaluation of comprehensive tests performed by an approved qualified testing laboratory indicating that each product complies with requirements.
- C. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
  - 1. After completion of installation, submit field sound transmission test data on installed work as specified hereinafter.
- D. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its products and systems are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- E. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- F. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: To include in maintenance manuals.
  - 1. User Guide: Furnish Owner with three (3) copies of complete brochure including recommended maintenance procedures, spare parts list, operating instructions and name and address of nearest service agent.
  - 2. Panel face finishes and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.



3. Seals, hardware, track, carriers, and other operating components.
4. Electric operator and controls.

## **1.6 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. Panel-Face Finish Material: Furnish full-width in quantity to cover both sides of tallest two panels when installed.

## **1.7 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by Installer. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Provide parts and supplies as used in the manufacture and installation of original equipment.
  1. Perform maintenance, including emergency callback service, during normal working hours.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications:
  1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
- C. Fire-Test-Response Characteristics: Provide operable panel partitions with the following fire-test-response characteristics, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  1. Surface-Burning Characteristics: As follows, per ASTM E 84:
    - a. Flame Spread: 25 or less.
    - b. Smoke Developed: 450 or less.
  2. Fire Growth Contribution: Textile wall coverings complying with the acceptance criteria of local building code requirements.

- D. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
    - a. Show typical components, attachments to building structure, and requirements of installation.
  2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
  3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
  4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
  5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

#### **1.9 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.
1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
    - f. Contractor's Independent Testing Laboratory.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  3. Record discussions, including decisions and agreements, and prepare report.

#### **1.10 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

1. Operable partition shall be installed to close across area with smooth floor surface, with variance less than or equal to 1/8 inch (3 mm).
2. Preparation of opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions. Plenum barrier construction shall provide an STC rating greater than or equal to that of scheduled Operable Partitions.

#### **1.11 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

#### **1.12 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Faulty operation of operable panel partitions.
  - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period: 2 years from date of Substantial Completion.

- B. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Failures include, but are not limited to, the following:
  - a. Structural failures including, but not limited to, excessive deflection.
  - b. Faulty operation of operable panel partitions
  - c. Deterioration of metals, metal finishes and other materials beyond normal wear.
2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for the following period of years from date of issuance of The Certificate of Substantial Completion.
  - a. Panel Warranty Period:
    - 1) Base Bid: 2 years.
    - 2) Alternate Bid: 10 years.
  - b. Trolley and Mechanically Operated Retractable Seals: 10 years.
  - c. Track, Brackets, Switches and Curves: 10 years.
  - d. Fixed Horizontal Top Seals: Lifetime of installation

- C. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 2 years from date of issuance of The Certificate of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.
  1. Manufacturers and Products - Ballrooms:
    - a. Advanced Equipment Corporation; Alpha Series, Type U.
    - b. Hufcor Inc.; 641 Series, Track 11.
    - c. Modernfold Inc.; Encore Series, Track 14.
  2. Manufacturers and Products - Meeting Rooms:
    - a. Advanced Equipment Corporation; Alpha Series, Type T.
    - b. Hufcor Inc.; 631 Series, Track 11.
    - c. Modernfold Inc.; Encore Series, Track 14.
- C. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
  1. Manufacturer and Product: Modernfold, Inc.; Encore Series

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. Design Loads: Engineer to withstand design loads including but not limited to gravity, wind, seismic, and erection design loads and thermal movements established by authorities having jurisdiction, applicable local building codes, and as indicated.

1. Structural Movement: Engineer to withstand movements of structure including, but not limited to, drift, twist, column shortening, long-term creep and deflection from uniformly distributed and concentrated live loads. Contractor shall obtain required design data and identify movements accommodated on submittal drawings.
    - a. Review partition loading with Architect to verify that allowable deflection of supporting structure will not restrict partition operation nor affect partition acoustics
  2. Deflection of Supporting Structure: Operable panel wall system shall be capable of withstanding building movements within the following limitations:
    - a. Total Deflection - Ballrooms: Not to exceed 1.5 inch (38 mm).
    - b. Total Deflection - Meeting Rooms: Not to exceed 0.75 inch (19 mm).
    - c. Total Deflection: Not to exceed 0.75 inch (19 mm).
- C. Acoustical Characteristics:
1. Noise Isolation Class (NIC): Manufacturer shall submit results of Noise Isolation Class (NIC) tests conducted by an independent testing agency of the same type wall systems, and of similar height and width, in accordance with ASTM E336-90.
    - a. Single Partitions: Refer to schedule at end of this section.
  2. Sound Transmission Class (STC): Manufacturer shall submit Laboratory test data performed in accordance with ASTM E90 and E413.
    - a. Single Partitions: Refer to schedule at end of this section.
    - b. STC: Not less than 52.
- D. Dimensional Tolerances: Engineer products and systems to accommodate dimensional tolerances of framing members and adjacent construction.

## 2.4 MATERIALS

- A. Steel Frame: Steel sheet, not less than 0.0598 inch (1.5 mm), 16 gage nominal specified thickness for uncoated steel.
- B. Aluminum Trim: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
- C. Steel Face/Liner Sheets: Tension-leveled steel sheet, not less than nominal specified thickness for uncoated steel.

## 2.5 OPERABLE PANEL PARTITIONS

- A. Panel Construction: Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
  1. Panel Faces: Tension-leveled steel sheet, minimum 16 gage nominal thickness or 18 gage nominal thickness; with laminated gypsum backer panel.

- B. Dimensions: Fabricate operable panel partitions, from manufacturer's standard sizes, to form an assembled system of dimensions indicated on Drawings and verified by field measurements.
- C. Cap-Trimmed Edges: If applicable, protective aluminum top and bottom edge trim with tight hairline joints concealing edges of panel and finish facing. One of the following as selected by Architect:
  - 1. Anodized Finish: Manufacturer's standard clear anodized.
  - 2. Powder Coat Finish: Manufacturer's standard baked polymer thermosetting powder finish.
- D. Vertical Trimless Edges: Fabricate vertical exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.
- E. Operable Panel Partition Characteristics:
  - 1. Each partition shall consist of panels of steel frame construction with internal glass fiber fill and sound barrier septum, as required, to achieve the specified design criteria. Panel construction shall be fabricated from formed steel with overlapped and welded corners for rigidity. Top channel shall be reinforced to support suspension system components.
  - 2. Individual panels shall have roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction.
- F. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
- G. Panel Thickness: As scheduled at the end of this section.

## **2.6 SEALS**

- A. General: Provide types of acoustical seals that produce operable panel partitions complying with acoustical performance requirements and the following:
  - 1. Seals made from materials and profiles that minimize sound leakage.
  - 2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended, closed, and in place.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: Continuous contact extruded vinyl bulb shaped sweeps with pairs of non-contacting vinyl fingers or PVC-faced, mechanical, constant-force-contact seal exerting uniform constant pressure on track when extended, ensuring horizontal and vertical sealing and resisting panel movement.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
  - 1. Mechanically Operated: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range and required operating clearance between retracted seal and floor finish. Partition manufacturer shall confirm deflection requirements to confirm bottom seal operating clearance and requirements.

- a. Horizontal Bottom Drop Seals: As scheduled at the end of this section.

## 2.7 FINISH FACING

- A. General: Install finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
  - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges and seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
  - 2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
  - 3. Match facing pattern 72 inches (1800 mm) above finished floor.
- B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.
  - 1. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.

## 2.8 SUSPENSION SYSTEMS

- A. Suspension Tracks: Steel tracks with steel running surfaces and adjustable steel hanger rods for overhead support, designed for type of operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.5 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  - 1. Panel Guide: Aluminum; finished with factory-applied, decorative, protective finish.
  - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish selected by Architect from manufacturer's full range.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with precision ground, sealed, ball-bearing, steel-tired wheels. Trolley shall be pre-programmed at the factory to allow automatic indexing of panels into pocket areas.
- C. Track Intersections, Switches, and Accessories: As required for type of operation, storage, track configuration, and layout indicated for operable panel partition and compatible with partition assembly specified. Fabricate track intersections and switches from steel with steel running surfaces. Track design will incorporate smooth switches and curves to accommodate pre-programmed automatic indexing trolleys.
- D. Aluminum Finish: Clear anodized, factory-applied, decorative finish, unless otherwise indicated.
- E. Steel Finish: Factory-applied, corrosion-resistant, protective coating, unless otherwise indicated.

## 2.9 ELECTRIC OPERATORS

- A. General: Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- D. Motor Electrical Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1.
- E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and "Off." Furnish two keys per station.
- F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.
  - 1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
  - 2. Sensor Mat: Electrically operated, contact-weight-sensitive safety mat in storage pocket area.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.
- I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:
  - 1. On storage pocket door, to prevent operation if door is not in fully open position.
  - 2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

## 2.10 ACCESSORIES

- A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware. Hinges in finish to match other exposed hardware. Provide pocket door configuration that allows partition seal to back of pocket.
  - 1. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See Division 08 section "Door Hardware" for lock cylinder and keying requirements.
- B. Pass Door; Single Leaf:



1. Pass Door: Matching pass door same thickness and appearance as partition panels. ADA compliant pass door shall be trimless and equipped with lever latch and push bar for panic operation. Threshold will not be permitted.
2. Closers: Concealed automatic door closures with full 180 degree opening range and hold open capability.
3. Exit Signs: Self illuminated chemical exit signs.
4. Panic Hardware: Recessed lever latch and recessed push bar. Surface mount push bar is not permitted. Push/pull knob or drop ring latch is not permitted.
5. Hinges: SOSS invisible hinges. Barrel or piano hinges are not permitted.
6. Trimless: Perimeter trim around door is not permitted. Splice in panel face at top of door is not permitted.
7. Viewer: Recessed door viewer.
8. Deadbolt Lock: Prepare door for lock cylinder.
9. Seals: Operable seals in door and adjacent panel legs, operable from edge of panel and door. Face operated seals on door or panel leg are not permitted.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
  1. The operable wall sub-contractor shall take responsibility for the ceiling/floor void barriers, interfaces with walls, etc and other associated constructions which may form possible significant noise flanking paths (if deemed necessary by the sub-contractor). These constructions shall be designed and installed such that the overall site sound separation performance requirements are met. The sub-contractor shall include the associated works within the sub-contract and/or approve the design and site installation of the associated constructions, prior to site level difference testing, sufficient for the sub-contractor to guarantee overall performance without doubt as to contractual responsibilities.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  1. Comply with ASTM E 557.
  2. Respective manufacturer's written installation instructions.
  3. Accepted submittals.
  4. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION OF OPERABLE PANEL PARTITIONS**

- A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- B. Installation personnel, experienced in the erection of the particular operable wall system furnished, shall be closely supervised by technician employed directly by the partition manufacturer.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
  - 1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. Testing Laboratory Field Service: Contractor shall engage and pay an approved qualified independent testing laboratory to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.
  - 1. Upon completion of this portion of the work, and prior to its acceptance by the Owner, the partition shall be set up by the manufacturer and field sound tested. Test price shall be included in the bid price. Prior to testing the operable partitions, the Architect and the partition manufacturer's representative will examine flanking paths through the surrounding building construction to determine that they will not significantly affect the performance of the operable partitions. The manufacturer shall complete the test with the Owner's Representative in attendance and shall make partition adjustments as required.
  - 2. Light Leakage Testing: Illuminate one side of partition installation and observe vertical joints and top / bottom seals; adjust partitions to eliminate voids.
  - 3. Noise Isolation Class (NIC) Testing: Perform testing of installed operable panel partitions for noise isolation according to ASTM E 336, determined by ASTM E413, and rated for not less than NIC indicated. Adjust partitions to comply with requirements.
  - 4. Extent of Testing: Testing agency shall randomly select partition installation for testing.
  - 5. Repair or replace partitions where test results indicate partitions do not comply with requirements; retest partitions.
  - 6. Additional testing and inspections, at Contractor's expense, shall be performed to determine compliance with requirements.

### **3.6 ADJUSTING**

- A. Adjust operable panel partitions and pocket doors to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.
- B. Electric Operator: Adjust operable panel partitions, hardware, electric operator, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- C. Storage Pocket Doors: Adjust storage pocket doors to operate smoothly and easily, without binding or warping.
- D. Pass Doors: Adjust pass doors to operate smoothly and easily, without binding or warping.

### **3.7 CLEANING AND PROTECTION**

- A. Clean soiled surfaces on completing installation of operable panel partitions, to remove dust, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure operable panel partitions are without damage or deterioration at time of Substantial Completion.
- C. Replace panels that cannot be cleaned and repaired, in a manner accepted by Architect, before time of Substantial Completion.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.
  - 1. Test and adjust seals, hardware, carriers, tracks, and other operable components. Replace damaged or malfunctioning operable components.
  - 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
  - 3. Review data in maintenance manuals. Refer to Division 01 Section "Closeout Procedures".
- A. **OPERABLE PANEL PARTITION SCHEDULE:** See Interior Finish Legend on drawings.

**END OF SECTION**

## SECTION 10 2613

### WALL AND CORNER GUARDS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Scope: Impact-resistant wall protection systems, wall and corner guards, and supplementary items necessary for installation.
- B. Related Section:
  - 1. Division 06 Section "Plastic (FRP) Panels" for non-impact resistant, glass-fiber reinforced (FRP) plastic panels.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, physical characteristics such as durability, resistance to fading, and flame resistance, construction details, installation instructions, and recommendations for maintenance
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Include for each wall protection system component to include in maintenance manuals specified in Division 1. Include recommended methods and frequency for maintaining optimum condition of plastic covers under anticipated traffic and use conditions, and precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Materials: Furnish as described below packaged with protective covering and identified with labels describing contents.
  - 1. Full-size units of maximum length, including plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but not less than 2 units.
  - 2. Accessory components from same production run as materials installed.

## **1.6 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: Provide wall protection system components with surface-burning characteristics indicated, as determined by testing identical materials according to ASTM E 84 by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify wall protection system components with appropriate markings of applicable testing and inspecting agency.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

## **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
  - 3. Record discussions, including decisions and agreements, and prepare report.

## **1.8 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

## **1.9 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
1. Alpar Architectural Products.
  2. American Floor Products Co., Inc.
  3. Arden Architectural Specialties, Inc.
  4. Construction Specialties, Inc. (C/S Group)
  5. IPC Door and Wall Protection Systems; Division of InPro Corporation.
  6. Korogard Wall Protection Systems; a division of RJF International Corporation.
  7. Pawling Corporation.
  8. Tepromark International, Inc.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

### **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### **2.3 MATERIALS**

- A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; extruded and sheet material, thickness as indicated.
- B. Engineered PETG (Polyethylene Terephthalate Glycol) Material: Textured, chemical- and stain-resistant, high-impact-resistant co-polymer plastic with integral color throughout; PVC-free with no PBTs or BPA, extruded and sheet material, thickness as indicated.
1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D 256, Test Method A.
  2. Chemical and Stain Resistance: Tested according to ASTM D 543 or ASTM D 1308.
  3. Self-extinguishing when tested according to ASTM D 635.
  4. Flame-Spread Index: 25 or less.
  5. Smoke-Developed Index: 450 or less.
  6. Color and Texture: As scheduled or as indicated in Design Selections.
- C. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.
- D. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.
- E. Brass: ASTM B 249/B 249M for extruded shapes and ASTM B 36/B 36 M for sheet.

- F. Solid Wood: Clear hardwood lumber of species indicated, free of appearance defects, and selected for compatible grain and color.
- G. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- H. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## **2.4 WALL AND CORNER GUARDS**

- A. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
  - 1. Manufacturers and Products: As scheduled or as indicated in Interior Finish Schedule.
- B. Drawing Designation BG - Surface-Mounted Bumper Rail Type Wall Guards:
  - 1. Description:
    - a. Cover: Snap-on type, extruded plastic; nominal 0.078 in (1.98 mm) thick; continuous in profile indicated.
    - b. Mounting Retainer: Continuous extruded aluminum retainer; nominal 0.072 in (1.83 mm) thick; with resilient cushion material between retainer and wall.
    - c. Accessories: Prefabricated, injection-molded matching end caps, inside and outside corners with concealed splices, mounting hardware and other accessories as required.
  - 2. Product Standard:
    - a. Drawing Designation BG: Refer to Interior Finish Legend.

## **2.5 PLASTIC / ALUMINUM RETAINER TYPE CORNER GUARDS**

- A. Drawing Designations CG-1, Surface-Mounted Non-Fire Rated Corner Guards:
  - 1. Description:
    - a. Cover: Snap-on type, extruded plastic; nominal 0.078 in (1.98 mm) thick; continuous in profile indicated with 1/4 inch corner radius.
    - b. Retainer: Continuous extruded aluminum retainer; nominal 0.070 in (1.78 mm) thick.
    - c. Accessories: Prefabricated, injection-molded matching top cap with concealed splices, mounting hardware and other accessories as required.
  - 2. Product Standards:
    - a. Drawing Designations CG-1: Refer to Interior Finish Legend.
- B. Drawing Designations EG - Surface-Mounted Non-Fire Rated End-of-Wall Corner Guards With Wall Protection Inset:

1. Description:
  - a. Cover: Snap-on type, extruded plastic; nominal 0.078 in (1.98 mm) thick; continuous in profile indicated with 1/4 inch corner radius.
  - b. Retainer: Continuous extruded aluminum retainer; nominal 0.070 in (1.78 mm) thick.
  - c. Accessories: Prefabricated, injection-molded matching top cap with concealed splices, mounting hardware and other accessories as required.
  - d. Inset: Surface-mounted plastic wall protection (WP) as indicated below.

## 2.6 STAINLESS STEEL TYPE CORNER GUARDS

### A. Drawing Designation CG-02 - Surface-Mounted Stainless Steel Corner Guards:

1. Description: Fabricated from 16 gage, type 304 stainless steel; 3-1/2 in x 3-1/2 in (87 by 87 mm) wings; with formed edges and 90 degree corner; with No. 4 directional, satin finish, with strippable plastic temporary protection.
2. Mounting Method: Stainless steel flat-head screws.
3. Product Standard:
  - a. Drawing Designation CG-02 : Refer to Interior Finish Legend.

## 2.7 PLASTIC WALL PROTECTION

### A. Drawing Designation WPC - Surface-Mounted Plastic Wall Protection:

1. Description: Fabricated from nominal 0.060 in (1.52 mm) thick extruded plastic sheets; with match wainscot and joint moldings and outside and inside corner trims as required.
2. Mounting Method: Adhesive.
3. Product Standard: Refer to Interior Finish Legend.

### B. Glass-Fiber Reinforced Plastic (FRP) Wall Protection: Refer to Division 06 Section "Plastic (FRP) Paneling".

## 2.8 FABRICATION

### A. General Requirements: Fabricate wall protection system components to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.

1. Preassemble components in shop to greatest extent possible to minimize field assembly.
2. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.



## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer/fabricator's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 EXAMINATION**

- A. Acceptance of Conditions: Examine substrate surfaces to which wall protection system components will be installed for compliance with requirements, installation tolerances and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance.

### **3.5 INSTALLATION**

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
  - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.
    - b. Where splices occur in horizontal runs of more than 20 ft (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 in (300 mm).
    - c. Adjust end and top caps as required to ensure tight seams.
- B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

### **3.6 CLEANING**

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

### **3.7 FINISH SCHEDULE**

- A. Color and Texture: As indicated on finish schedule sheet.

**END OF SECTION**



**SECTION 10 2813**  
**TOILET ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Toilet accessories and supplementary items necessary for installation.

**1.2 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, dimensions, and profiles of individual components.
  - 2. Include details for cutouts required in other Work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- B. Warranty: Sample of special warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For inclusion in operation and maintenance manual as required by Division 01 Section "Operation and Maintenance Data". Include manufacturer's instructions for maintenance of installed Work, including methods and frequency for maintaining optimum condition under anticipated use. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

**1.5 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
  - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
  - b. Review Contract Document requirements.
  - c. Review approved submittals.
  - d. Review inspection and testing requirements.
  - e. Review environmental conditions and procedures for coping with unfavorable conditions.
  - f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## **1.6 COORDINATION**

- A. Coordinate installation of products with interfacing and adjoining construction to provide a successful installation without failure.

## **1.7 WARRANTY**

- A. Mirror Manufacturer's Warranty: Furnish warranty for a period of 15 years from date of Substantial Completion agreeing to replace mirrors that develop visible silver spoilage defects, signed by an authorized representative using manufacturer's standard form.
- B. Hand Dryer Manufacturer's Warranty: Furnish warranty for a period of 10 years from date of Substantial Completion agreeing to repair or replace defective or faulty dryers, signed by an authorized representative using manufacturer's standard form.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to Conditions of the Contract and Division 01 Section "Substitution Procedures".
  1. A & J Washroom Accessories, Inc.
  2. American Specialties, Inc.
  3. Bobrick Washroom Equipment, Inc.
  4. Bradley Corp.
  5. Brey Krause Manufacturing.
  6. GAMCO, a Division of Bobrick.
- B. Shower Curtain Products Only:
  1. Barjan Manufacturing Ltd.
  2. Brite Inc.
  3. Gary Manufacturing.

- C. Basis of Design: Contract Documents are based on products specified to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change intended aesthetic, functional and performance requirements as judged by Architect.

## **2.2 MATERIALS, GENERAL**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. General Requirements:
  - 1. Unless otherwise indicated, fabricate units of all-welded construction, with corners and returns as indicated, tight seams and joints, and exposed edges rolled.
  - 2. Fabricate frames drawn and leveled, one-piece seamless construction.
  - 3. Hang doors and access panels with full-length, stainless-steel hinges.
  - 4. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- C. Manufacturer Names or Labels: Not permitted on exposed faces of accessories. Provide printed label or stamped metal nameplate indicating manufacturer's name and product model number on an easily noticeable interior surface or on back surface of each accessory.
- D. Keys: Provide minimum of 6 universal keys for internal access to accessories for servicing and resupplying.
- E. Accessibility Requirements: Products and installation shall comply with Americans with Disabilities Act (ADA), ANSI A 117.1, and state and local accessibility standards.

## **2.3 MATERIALS**

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 satin finish; minimum 0.0312 in (0.8 mm) (22 gage) nominal thickness unless otherwise indicated.
- B. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 1/4 in (6 mm) thick, with silvering, electroplated copper coating, and protective organic coating.
- C. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- D. ABS Plastic: Moldable acrylonitrile-butadiene-styrene resin formulation.
- E. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of non-corrosive metal when concealed.
- G. Sealant: Silicone mildew resistant sealant specified in Division 07 Section "Joint Sealants".

## **2.4 PAPER TOWEL DISPENSERS**

- A. Drawing Designation A1 - Surface-Mounted Paper Towel Dispenser:
  - 1. Description: Fabricated of stainless steel; with hinged front equipped with full length stainless steel piano hinge and tumbler lock; pierced slots at sides as refill indicators; and sized to dispense not less than 400 C-fold or 525 multi-fold paper towels without special adapters.

2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-262.
- B. Drawing Designation A2 – Surface Mounted Automatic Paper Towel (Roll) Dispenser:
1. Description: Surface mounted, automatic motion sensing mechanism with user-adjustable delay and paper towel length; battery powered. Sized to dispense 8-inch- (203-mm-) wide, 800-foot- (244-m-) long roll. Lockset: Tumbler type.
  2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-72974.
- C. Drawing Designation A3 - Recessed-Mounted Paper Towel Dispenser:
1. Description: Fabricated of stainless steel; with seamless exposed flange and hinged front equipped with full length stainless steel piano hinge, door-swing cable limiter, and tumbler lock; sized to dispense not less than 350 C-fold or 475 multi-fold paper towels without use of special adapters; for nominal 4 in (100 mm) wall depth.
  2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-359.

## 2.5 TOILET TISSUE DISPENSERS

- A. Drawing Designation B1 - Surface-Mounted Single-Roll Toilet Tissue Dispenser:
1. Description: Fabricated of heavy duty cast aluminum; sized to accommodate 5 in (125 mm) diameter core type tissue roll; molded ABS spindle, theft-resistant, with retractable pin and concealed locking mechanism.
  2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-2730.
- B. Drawing Designation B2 - Surface-Mounted Double-Roll Toilet Tissue Dispenser:
1. Description: Fabricated of heavy duty cast aluminum; sized to accommodate two separate 5 in (125 mm) diameter core type tissue rolls; molded ABS spindle, theft-resistant, with retractable pin and concealed locking mechanism.
  2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-2740.
- C. Drawing Designation B3 - Surface-Mounted Multi Roll Toilet Tissue Dispenser:
1. Description: Fabricated of stainless steel; with hinged front equipped with pivot hinge and tumbler lock; sized to store and dispense two 5 in (125 mm) diameter core type tissue rolls with reserve roll placed in service automatically when bottom roll is depleted; molded ABS spindle, theft-resistant, and held in dispenser when door is locked.
  2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-2888.
- D. Drawing Designation B4: SURFACE – PARTITION-MOUNTED
- 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-386
- D. Drawing Designation B5 - Recessed-Mounted Toilet Paper Holder (Psychiatric Use):
1. Description: Fabricated of stainless steel with seamless exposed flange; concealed mounting clamp studs for stud walls with spanner head exposed fasteners; chrome plated spindle with internal spring.
  2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-6677.
- E. Drawing Designation B6 - Recessed-Mounted Multi Roll Toilet Tissue Dispenser:

1. Description: Fabricated of stainless steel; with seamless exposed flange and hinged front equipped with pivot hinge and tumbler lock; sized to store and dispense two 5 in (125 mm) diameter core type tissue rolls with reserve roll placed in service automatically when bottom roll is depleted; molded ABS spindle, theft-resistant and held in dispenser when door is locked; for nominal 4 in (100 mm) wall depth.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-3888.

## **2.6 SANTARY NAPKIN DISPOSALS**

### **A. Drawing Designation E1 - Surface-Mounted Sanitary Napkin Disposal Unit:**

1. Description: Fabricated of stainless steel; with flush door equipped with continuous piano hinge and tumbler lock; self-closing disposal panel with spring-loaded full length stainless steel piano hinge and international symbol for sanitary napkin disposal; with removable 1.2 gal (4.6 L) capacity molded polyethylene receptacle.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-254.

### **B. Drawing Designation E2 - Recessed-Mounted Sanitary Napkin Disposal Unit:**

1. Description: Fabricated of stainless steel; with seamless exposed flange; with flush door equipped with continuous piano hinge and tumbler lock; self-closing disposal panel with spring-loaded full length stainless steel piano hinge and international symbol for sanitary napkin disposal; with removable 1.2 gal (4.6 L) capacity molded polyethylene receptacle; for nominal 4 in (100 mm) wall depth.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-353.

### **C. Drawing Designation E3 - Partition-Mounted Dual-Access Sanitary Napkin Disposal Unit:**

1. Description: Fabricated of stainless steel; with seamless adjustable exposed flange at both partition faces; self-closing disposal panel at both partition faces with spring-loaded full length stainless steel piano hinge and international symbol for sanitary napkin disposal; with removable 1.2 gal (4.6 L) capacity molded polyethylene receptacle.
2. Basis of Design: Bobrick Washroom Equipment, Inc. Model B-354.

## **2.7 GRAB BARS**

### **A. Drawing Designation G1, G2, G3, G4, G5, G6 G8, G9, G10 - Straight Surface-Mounted Satin Finish Grab Bar with Slip-Resistant Gripping Surface:**

1. Description: Fabricated of stainless steel tube; with minimum 0.050 in (1.25 mm) (18 gage) wall thickness and 1-1/2 in (38 mm) outside diameter, with 1-1/2 in (38 mm) clearance between wall surface and inside face of bar.
  - a. Gripping Surfaces: Satin texture with peened gripping surfaces.
  - b. Shapes: Either as indicated, or as required by condition requiring grab bar.
  - c. Mounting: Concealed flanged steel plate welded to end of bar, as required by mounting condition, with snap-on cover; engineered to support minimum 300 lbs (136 kg).



Basis of Design:

- a. TYPE 1: HORIZONTAL – 18 INCHES
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6806 x 18
- b. TYPE 2: HORIZONTAL – 24 INCHES
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6806 x 24
- c. TYPE 3: HORIZONTAL – 30 INCHES
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6806 x 30
- d. TYPE 4: HORIZONTAL – 36 INCHES
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6806 x 36
- e. TYPE 5: HORIZONTAL – 42 INCHES
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6806 x 42
- f. TYPE 6: VERTICAL – 18 INCHES
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6806 x 18
- g. TYPE 7: L-SHAPED, HORIZONTAL – 42"x54"
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-6897
- h. TYPE 8: L-SHAPED, HORIZONTAL – 16"x30"
  - 1) Manufacturer: A & J Washroom Accessories
  - 2) Model Number: UG30X-G3016
- i. TYPE 9: U-SHAPED, HORIZONTAL – 24"x60"x24"
  - 1) Manufacturer: A & J Washroom Accessories
  - 2) Model Number: UG30X-V246024

**2.8 SOAP DISPENSERS**

A. Drawing Designation – ITEM J:

1. Basis of Design:

- a. TYPE 1: SURFACE - MANUAL
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-4112
- b. TYPE 2: SURFACE - AUTOMATIC
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-2012
- c. TYPE 3: RECESSED - MANUAL
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-4063
- d. TYPE 5: COUNTER - MANUAL
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-822
- e. TYPE 6: COUNTER - AUTOMATIC
  - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
  - 2) Model Number: B-826

## 2.9 SOAP DISHS

- A. Drawing Designation – ITEM K
  - 1. Basis of Design:
    - a. TYPE 1 SURFACE
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-6807
    - b. TYPE 2: RECESSED
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-4380
    - c. TYPE 3: RECESSED - CERAMIC
      - 1) Refer to Division 09, Section “TILING”.

## 2.10 FOLDING SHOWER SEATS

- A. Drawing Designation – ITEM L:
  - 1. Basis of Design:
    - a. TYPE 1: WALL-MOUNTED – PADDED
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-517 (right hand); B-518 (left hand)
    - b. TYPE 2: WALL-MOUNTED – COMPOSITE
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-5181 (reversible)

## 2.11 CHANGING STATIONS

- A. Drawing Designation – ITEM M:
  - 1. Basis of Design:
    - a. TYPE 1: SURFACE - HDPE
      - 1) Manufacturer: Koala Kare Products / Bobrick
      - 2) Model Number: KB200 (horizontal)
    - b. TYPE 2: SURFACE – STAINLESS STEEL
      - 1) Manufacturer: Koala Kare Products / Bobrick
      - 2) Model Number: KB110-SSWM (horizontal)
    - c. TYPE 3: RECESSED - HDPE
      - 1) Manufacturer: Koala Kare Products / Bobrick
      - 2) Model Number: KB100-ST (horizontal)
    - d. TYPE 4: RECESSED – STAINLESS STEEL
      - 1) Manufacturer: Koala Kare Products / Bobrick
      - 2) Model Number: KB110-SSRE (horizontal)

## 2.17 MIRRORS

- A. Drawing Designation – ITEM P:
  - 1. Basis of Design:
    - a. TYPE 1: STAINLESS STEEL FRAME
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-295 x 18
    - b. TYPE 2: STAINLESS STEEL FRAME WITH SHELF
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-676 x 24
    - c. TYPE 3: TILT STAINLESS STEEL FRAME
      - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
      - 2) Model Number: B-287
    - d. TYPE 4: SELF-ILLUMINATED
      - 1) Manufacturer: Electric Mirror

- 2) Model Number: Novo Lighted Mirror
- 3) Sizes:
  - a) 24 inch x 36 inch

**2.19 ROBE HOOKS**

B. Drawing Designation – ITEM R:

- 1. Basis of Design:
  - a. TYPE 1: SINGLE
    - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
    - 2) Model Number: B-6717
  - b. TYPE 2: DOUBLE
    - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
    - 2) Model Number: B-76727

**2.20 SANITIZER DISPENSERS**

A. Drawing Designation – ITEM T:

- 1. Basis of Design:
  - a. TYPE 1: SURFACE - MANUAL
    - 1) Manufacturer: Purell Hand Sanitizer
    - 2) Model Number: S-14836
  - b. TYPE 2: SURFACE - AUTOMATIC
    - 1) Manufacturer: Purell Hand Sanitizer
    - 2) Model Number: H-1950

**2.21 MOP AND BROOM HOLDERS**

A. Drawing Designation – ITEM U:

- 1. Basis of Design:
  - a. TYPE 1: WITH SHELF
    - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
    - 2) Model Number: B-224 x 36
  - b. TYPE 2: WITHOUT SHELF
    - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
    - 2) Model Number: B-223 x 36

**2.22 ROD, HOOKS, AND CURTAINS**

A. Drawing Designation – ITEM V:

- 1. Basis of Design:
  - a. TYPE 1: CURVED ROD
    - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
    - 2) Model Numbers:
      - a) Rod: B-4207 x 72 (72 inch); B-4207 x 60 (60 inch)
      - b) Hooks: B-204-1
      - c) Curtain: B-204-2 (42 inch); B-204-3 (70 inch)
  - b. TYPE 2: STRAIGHT ROD
    - 1) Manufacturer: Bobrick Washroom Equipment, Inc.
    - 2) Model Numbers:
      - a) Rod: B-207 x 72 (72 inch); B-207 x 60 (60 inch); B-207 x 48 (48 inch); B-207 x 36 (36 inch).
      - b) Hooks: B-204-1
      - c) Curtain: B-204-2 (42 inch); B-204-3 (70 inch)

## **2.25 GLOVE DISPENSERS**

### **A. Drawing Designation – ITEM X:**

1. Basis of Design:
  - a. TYPE1: STAINLESS STEEL - DOUBLE
    - 1) Manufacturer: Dynamic Diagnostics
    - 2) Model Numbers: 300015
  - b. TYPE 2: STAINLESS STEEL - TRIPLE
    - 1) Manufacturer: Dynamic Diagnostics
    - 2) Model Numbers: 300014
  - c. TYPE 3: STAINLESS STEEL - QUAD
    - 1) Manufacturer: Dynamic Diagnostics
    - 2) Model Numbers: 300013

## **3 EXECUTION**

### **3.19.1.1 EXAMINATION**

3.19.1.1.1 Acceptance of Surfaces and Conditions: Examine substrates to receive products and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.19.1.2 INSTALLATION, GENERAL**

3.19.1.2.1 Installation Quality Standards: In addition to standards listed elsewhere, install toilet accessories according to the following, unless otherwise specified in this Section:

- 3.19.1.2.1.1 Respective manufacturer's written installation instructions.
- 3.19.1.2.1.2 Accepted submittals.
- 3.19.1.2.1.3 Contract Documents.

### **3.19.1.3 PREPARATION**

3.19.1.3.1 General: Comply with manufacturer's instructions, recommendations and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.19.1.4 INSTALLATION**

3.19.1.4.1 General Requirements: Install toilet accessories level, plumb, and firmly anchored in locations and at heights indicated. Use fasteners that are appropriate to substrate indicated and as recommended by respective product manufacturer.

3.19.1.4.2 Grab Bars: Install to withstand downward load of minimum 250 lbf (1.10 kN) according to ASTM F 446.

3.19.1.4.3 Accessories within Shower and Tub Alcoves: Set flanges of accessories in sealant, install sealant in screw holes prior setting screws, and cover screw head prior to snapping on cover, to prevent water infiltration.

3.19.1.4.4 Mirrors: Secure to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws.

**END OF SECTION**

## SECTION 10 4400

### FIRE-PROTECTION SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required for this section includes fire protection specialties (fire extinguishers, cabinets, accessories) and supplementary items necessary to complete their installation.
- B. Cabinets for fire protection standpipe and hose systems are specified in Division 21.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 2. Fire Extinguishers: Include rating and classification.
  - 3. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

##### 1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

##### 1.4 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

##### 1.5 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS AND PRODUCTS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  - 1. J. L. Industries, Inc.; a division of Activar Construction Products Group.
  - 2. Larsen's Manufacturing Company.

3. Potter Roemer LLC.

## 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

## 2.3 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666/A 666M, Type 302 or Type 304 alloy.

## 2.4 PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.
- B. Multipurpose Dry Chemical Type; typical unless otherwise indicated or specified: UL-rated 2A:10B:C, 5-lb nominal capacity, in enameled steel container.

## 2.5 FIRE-PROTECTION CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
- B. Cabinet:
1. Material:
    - a. Stainless steel.
  2. Type: Suitable for 10 lb. Fire extinguisher.
  3. Mounting:
    - a. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
  4. Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth. Same metal and finish as door.
    - a. Exposed Trim: 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 in (32 mm) to 1-1/2 in (38 mm) backbend depth.
  5. Door Material:
    - a. Stainless steel.
  6. Door Glazing: Manufacturer's standard tempered float glass (clear).
  7. Door Style: Manufacturer's standard vertical duo panel design.
  8. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected. Provide minimum 1/2 in (12mm) thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
  9. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either

lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

## **2.6 ACCESSORIES**

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish. Provide brackets for extinguishers not located in cabinets.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.
  - 1. Bracket-Mounted Extinguishers: Identify with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
  - 2. Fire Extinguisher Cabinet: Identify with the words "FIRE EXTINGUISHER" in black die cut vinyl letters applied to door.

## **2.7 GENERAL FINISH REQUIREMENTS, FIRE-PROTECTION CABINETS**

- 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 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 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.

## **2.8 STEEL FINISHES, FIRE-PROTECTION CABINETS**

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## **2.9 STAINLESS-STEEL FINISHES, FIRE-PROTECTION CABINETS**

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: No. 4.



## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
  - 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
  - 2. Fasten cabinets to structure, square and plumb.

### **3.5 ADJUSTING, CLEANING, AND PROTECTION**

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

**END OF SECTION**

**18-01.01 WPMHC Expansion  
Childers Architect  
2019-12-06**

**FIRE-PROTECTION SPECIALTIES**

**10 4400 - 5**

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

**FIRE-PROTECTION SPECIALTIES**

**10 4400 - 6**

## **SECTION 10 5113**

### **METAL LOCKERS**

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

##### **1.1 SUMMARY**

A. Work required for this Section includes metal lockers and supplementary items necessary to complete their installation.

##### **1.2 ACTION SUBMITTALS**

A. Product Data: Manufacturer's technical literature for each product and system indicated.

1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance for each type of locker and bench.

B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work

1. Show locker fillers, trim, base, tops, and accessories. Include locker-numbering sequence.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

D. Samples for Verification: For each locker color selected, in manufacturer's standard size samples, but not less than 4 inch square, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the Work.

##### **1.3 CLOSEOUT SUBMITTALS**

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 01.

##### **1.4 QUALITY ASSURANCE**

A. Regulatory Requirements: Unless otherwise indicated, at least 5 percent but no less than one of each type of lockers shall comply with accessibility requirements, of the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG).

1. Provide not less than one shelf located within required reach ranges.

2. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.

##### **1.5 PRE-INSTALLATION CONFERENCE**

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

## 1.6 COORDINATION

A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS AND PRODUCTS

A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

B. Bases of design:

- a. 6' high, 12"W X 24"H X 15" D triple tier, one wide, and three wide. With sloping top, end and front base, with resettable factory installed combination lock.
- b. 6' high, 12"W X 24"H X 15" D four tier one wide and three wide. With sloping top, end and front base.
- c. 6' High, 15" W X 24"H X 18" D triple tier, one wide and three wide. With sloping top, end and front base.

1. Art Metal Products; Standard K.D. Lockers.
2. ASI Storage Solutions Inc.; Traditional Collection.
3. DeBourgh Mfg. Co.; Worley Lockers.
4. List Industries Inc.; Classic Line of Superior KD Lockers.
5. Lyon Workspace Products, LLC; Standard Lockers.
6. Penco Products, Inc.; Vanguard Lockers.
7. Republic Storage Systems Company; Standard Lockers.
8. Salisbury industries

### 2.2 MATERIALS, GENERAL

A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### 2.3 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 366, matte finish, suitable for exposed applications, and stretcher leveled or roller leveled to stretcher-leveled flatness.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

### 2.4 WARDROBE LOCKERS

A. Body: Form backs, tops, bottoms, sides, and intermediate partitions from 0.0239 inch (24 gage) minimum steel sheet; flanged for double thickness at back vertical corners.

- B. Frames: Form channel frames from minimum 0.0598-inch- thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.
  - 1. Latch Hooks: Form from minimum 0.1046-inch- thick steel; welded or riveted to door frames.
  - 2. Cross Frames for Multi-Tier Lockers: Form intermediate channel cross frames between tiers from minimum 0.0598-inch- (1.50-mm-) thick steel sheet. Weld to vertical frame members.
- C. Doors: One-piece 0.0598 inch (16 gage) minimum steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees.
  - 1. Reinforcement: Brace or reinforce inner face of doors more than 15 inches wide.
  - 2. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
  - 3. Louvered Vents: Stamped, louvered vents in door face, as follows:
    - a. Single-Tier Lockers: No fewer than six louver openings at top and bottom.
    - b. Double-Tier Lockers: No fewer than three louver openings at top and bottom.
    - c. Multiple-Tier Lockers: No fewer than two louver openings at top and bottom, or three louver openings at top or bottom.
- D. Shelves: Provide hat shelf in single-tier units; fabricated from minimum 0.0239-inch- thick, formed steel sheet; flanged on all edges.
- E. Hinges: Steel, full loop, five or seven knuckle; tight pin; minimum 2 inches high. Weld to inside of door frame and attach to door with at least two factory-installed fasteners that are completely concealed and tamper resistant when door is closed.
  - 1. Provide at least three hinges for each door more than 42 inches high and at least two hinges for each door 42 inches high or less.
- F. Recessed Handle and Latch: Manufacturer's standard housing, formed from 0.0359-inch- thick nickel-plated steel or stainless steel, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch, as follows:
  - 1. Provide minimum three-point latching for each door more than 42 inches high; minimum two-point latching for each door 42 inches high or less.
    - a. Provide strike and eye for padlock.

## 2.5 BUILT-IN LOCKS

- A. Fabricate lockers to receive the following locking devices, installed on lockers using security-type fasteners:
  - 1. Combination Locks: Built-in key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key. Comply with the following:
    - a. Bolt Operation: Manually locking dead bolt or automatically locking spring bolt, as standard with manufacturer.

## **2.6 LOCKER ACCESSORIES**

A. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:

1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks for single-, double-, and triple-tier units. Attach hooks with at least two fasteners.

2. Coat Rods: Manufacturer's standard galvanized steel. Provide rod in lieu of ceiling hook for lockers 18 inches deep or greater.

B. Number Plates: Manufacturer's standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

C. Continuous Metal Base: Minimum 0.0598-inch- (16 gage) thick steel sheet, 6 inch high channel or zee profiled for stiffness, fabricated in lengths as long as practicable to enclose base and base ends of lockers, and finished to match lockers.

D. Continuously Sloping Tops for Non-Recessed Units: Manufacturer's standard, fabricated from minimum 0.0359-inch- (20 gage) thick steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and vertical end closures.

E. Recess Trim for Recessed Units: Manufacturer's standard; fabricated from minimum 0.0478-inch- (18 gage) thick steel sheet, minimum 2-1/2-inch face width, and finished to match lockers. Fabricate trim in lengths as long as practicable.

F. Filler Panels: Manufacturer's standard; fabricated from minimum 0.0478-inch- (18 gage) thick steel sheet in an unequal leg angle shape, and finished to match lockers. Provide slip joint filler angle formed to receive filler panel.

G. Finished End Panels for Non-Recessed Units: Manufacturer's standard; fabricated from minimum 0.0239-inch- (24 gage) thick steel sheet, finished to match lockers, and designed for concealing exposed ends of non recessed lockers.

## **2.7 LOCKER BENCHES**

A. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges, of the following material; minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick) except provide minimum 20-inch- (508-mm-) wide tops where accessible benches are indicated.

1. Laminated Maple: Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

B. Pedestals: Provide manufacturer's standard pedestal supports, with predrilled fastener holes, complete with fasteners and anchors, and as follows:

1. Fixed Type: Tubular steel, minimum 1-1/4-inch diameter, with minimum 0.1345-inch-thick steel flanges welded at top and base, and baked-enamel finish; floor anchored with exposed fasteners.

2. Color: Match locker units.

C. Furnish a minimum of two pedestals for each bench, with pedestal spacing not more than 72 inches o.c.

## **2.8 FABRICATION**

- A. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.
  - B. Knocked-Down Construction: Fabricate lockers for nominal assembly at Project site.
  - C. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece assembly.
1. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet, unless otherwise indicated.

## **2.9 FINISHES, GENERAL**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **2.10 STEEL SHEET FINISHES**

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.
  - B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils on doors, frames, and legs, and 1.1 mils elsewhere.
1. Color and Gloss: Gray.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:



1. Respective manufacturer written installation instructions.
2. Accepted submittals.
3. Contract Documents.

### **3.3 PREPARATION**

A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 INSTALLATION**

A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.

- B. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.
- C. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.
- D. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Recessed Units:

- a. Attach recess trim to recessed lockers with concealed clips.

2. Non-Recessed Units:

- a. Attach sloping top units to lockers, with closures at exposed ends.
  - b. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of non-recessed lockers.

E. Fixed Locker Benches: Anchor locker benches to floor. Uniformly space pedestals not more than 72 inches apart and securely fasten to bench top and anchor to floor.

### **3.5 ADJUSTING, CLEANING, AND PROTECTION**

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

- B. Clean interior and exposed exterior surfaces and polish stainless-steel and nonferrous-metal surfaces.
- C. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit locker use during construction.
- D. Touch up marred finishes, or replace locker units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

**3.6 LOCKER SCHEDULE**

A. Refer to Interior Finish Schedule on drawings.

**3.7 FINISH SCHEDULE**

A. Locker Color and Gloss: Gray.

**END OF SECTION**



## SECTION 10 7310

### ALUMINUM WALKWAYS AND CANOPIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Aluminum walkway covers and canopies and supplementary items necessary for installation.

##### 1.2 DESCRIPTION OF WORK

- A. Definition: Aluminum walkways and canopies shall consist entirely of extruded aluminum sections (roll-formed not acceptable). System shall consist of heli-arc welded, one-piece rigid structural bents (column and beam assemblies), decking, fascia, accessory items and hardware to provide a complete system.
- B. Water shall drain from deck into designated beams and out at grade level of columns through weepholes.

##### 1.3 DELEGATED ENGINEERING REQUIREMENTS

- A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required and shall not be construed as an engineered design. Furnish and install all Work required for a complete installation.
- B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents including, but not limited to, the following.
  - 1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated Engineering Professional Qualifications: Professional engineer legally authorized to practice in Florida and experienced in providing engineering services of kind indicated for products and systems similar to this Project and has a record of successful in-service performance.
- D. Coordination of Contract Documents and Work:
  - 1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturers, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.

2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  1. Submit detailed drawings, layout of canopies system, bent locations (identify drain columns and wet bents), all mechanical joint locations with complete details, connections, jointing and accessories. Include details of concrete footings and bent anchorage.
  2. Submit complete details with structural properties (moment of inertia, section modulus, modulus of elasticity, etc.) for all proposed sections (beams, columns, decking and other structural members).

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Delegated Engineering Calculations: Informational submittal for products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation; test reports are not acceptable substitute for calculations.
- B. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.
- C. Qualification Data: For manufacturer, installer, and professional engineer.
  1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer with not less than 10 years experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 10 years, and with sufficient production capability, facilities, and personnel to produce required Work.
- B. Installer Qualifications:

1. Experience: Installer with not less than 5 years experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 5 years, and with sufficient production capability, facilities, and personnel to produce required Work.
  2. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
  3. Manufacturer/Fabricator Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- C. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with minimum of 5 years experience in providing recommendations, observations, evaluations, and problem diagnostics. Sales representatives are not acceptable.
- D. Codes and Standards: Comply with provisions of the following except as otherwise indicated:
1. International Building Code, latest addition with amendments, if any.
  2. AWS (American Welding Society) standards for structural aluminum welding.

#### **1.7 DELIVERY, STORAGE AND HANDLING:**

- A. Deliver, store and handle covered walkway system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

#### **1.8 PROJECT CONDITIONS**

- A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

#### **1.9 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
1. DITT-Deck Extruded Aluminum Walkway Cover System.
- B. Available Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.

1. AVAdek Walkway Cover Systems and Canopies.
2. DITT-Deck Extruded Aluminum Canopies System by Dittmer Architectural Aluminum.
3. Mapes Industries.
4. Peachtree Protective Covers, Inc.
5. Superior Metal Products, LLC

## **2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Engineer products and systems to withstand loads within limits of allowable working stresses of the materials involved under conditions indicated and without permanent deformation or failure of materials.
- B. System Performance: Provide aluminum covered walkway system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live loading, dead loading and wind loading in compliance with International Building Code requirements for geographic area in which work is located and as follows:
  1. Live Load: 20 psf minimum
  2. Structural design for wind forces: Comply with ANSI A58.1-1982
  3. Design Wind Velocity: 110 mph.
  4. Stability Criteria: Florida Building Code
- C. Sizes shown on drawings are to be considered minimum.
- D. Structure shall be capable of sustaining severe icing, hail, hurricane force winds and supporting a concentrated load such as being walked upon.

## **2.3 MATERIALS**

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. All aluminum extrusions shall be alloy 6063 heat treated to a T-6 temper.
- C. Standard finish for all components shall be satin anodized 204-R1 meeting Aluminum Association Specification AA-M-10C-22A-21.
- D. Fasteners:
  1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8" outside dimension, conical washer.
  2. Fascia Rivets: Size 3/16" by 1/2" grip range aluminum rivets with aluminum mandrel.
  3. Bolts: All bolts, nuts and washers to be 18-8 non-magnetic stainless steel.
  4. Tek Screws: Not permitted.

## **2.4 FABRICATION**

- A. Comply with indicated profiles, dimensioned requirements, and structural requirements.
- B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.
- C. All welding do be done by heli-arc process.

- D. Mechanical joints shall consist of stainless steel bolts with a minimum of two (2) bolts per fastening. Bolts and nuts shall be installed in a concealed manner utilizing 1/2" thick by 1 1/2" aluminum bolt bars welded to structural members. All such mechanical joints must be detailed on shop drawings showing all locations.
- E. Roof Deck: Extruded Aluminum shapes, interlocking self-flashing sections. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16'- 0" to offset dead load deflections. Welded dams are to be used at non-draining ends of deck.
- F. Expansion joints, design structure for thermal expansion and contraction. Provide expansion joints as required.
- G. Exposed rivets used to fasten bottom of fascia to deck to have finish to match fascia.
- H. Apply a shop applied dip-coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Column ends shall be pierced to "key" grout to bent for maximum uplift protection.
- I. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- J. Concealed Drainage: Water shall drain from the roof deck to the beams to the columns and drain above ground or below ground and tie into storm sewer. Reference drawings for locations and type.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

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

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials. Protect aluminum embedded or otherwise in contact with concrete and masonry with alkali resistant clear acrylic.



### **3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.4 CONCRETE FOOTINGS**

- A. Concrete footings are not work of this section. Refer to Division 03 Section "Cast-in-Place Concrete".
- B. Sleeves (styrofoam blockouts) shall be furnished by canopies manufacturer and placed by general contractor.

### **3.5 INSTALLATION**

- A. Erection: Set roof support frames into pockets provided in top of footings or anchor with anchor bolts and base plates as required; set to required elevations, align, plumb and level; and grout in place with 2,000 psi Portland cement grout. Assure that grout fills all voids and "keys" to columns. Fill downspout units with grout to bottom of discharge level. Install aluminum deflectors after grouting. Follow manufacturer's instructions. Match to finish and elevation of adjacent sidewalks.
- B. Install roof deck sections, accessories and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.
- C. Take extreme care to prevent damage or scratching. Replace damaged components prior to installation. All workmanship must be top quality with neat miters and fitted joints.

### **3.6 FLASHING**

- A. Flashings: Flashings required between covered walkway system and adjoining structures are not work of this section. Refer to Division 07 Section "Sheet metal Flashing and Trim".

### **3.7 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall inspect first day's Work and periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

### **3.8 CLEANING AND PROTECTION**

- A. Damaged Units: Replace roof deck panels and other components of the work which have been damaged or have deteriorated beyond successful minor repair.
- B. Cleaning: Remove protective coverings at time in project construction sequence which will afford greatest protection of work. Clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.

- C. Protection: Advise Contractor of protection and surveillance procedures, as required to ensure that work of this section will be without damage or deterioration at time of substantial completion.

END OF SECTION

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

**ALUMINUM WALKWAYS AND**  
**CANPIES**

**10 7310 - 8**

## SECTION 11 1300

### LOADING DOCK EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Work required for this section includes loading dock equipment and supplementary items necessary to complete their installation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Include accessories, details of construction relative to materials, dimensions of individual components, profiles, and finishes.
  - 1. Dock Leveler: Include rated capacities for each unit.
- B. Shop Drawings: Show details of fabrication and installation. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Provide templates for anchors and bolts anchored to permanent construction.
  - 2. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring for the following:

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports for Dock Levelers: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent professional engineer, indicate compliance of dock levelers with requirements of MH 30.1 for determining rated capacity, based on comprehensive testing within the last two years of current products.
- B. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For loading dock equipment to include in the maintenance manuals specified in Division 01. Include name, address, and telephone number of manufacturer's nearest authorized service representative.

##### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.
- B. Installer Qualifications: Engage an experienced installer who is an authorized representative of loading dock equipment manufacturer for both installation and maintenance of the type 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. Dock Leveler Standard: Comply with MH 30.1, "Safety, Performance and Testing of Dock Leveling Devices." (Formerly MH 14.1)
- D. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of the various items of loading dock equipment and are based on the specific types and models indicated. Similar equipment by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.
- E. Preinstallation Conference: Conduct conference at Project site.
1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
  2. Review sequence of operation for each type of loading dock equipment.
  3. Review coordination of interlocked equipment specified in this Section and elsewhere.
  4. Review required testing, inspecting, and certifying procedures.

## **1.6 WARRANTY**

- A. Dock-Leveler Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace dock-leveler components that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures, including cracked or broken structural support members and load-bearing welds.
  2. Deck plate failures, including cracked plate or permanent deformation in excess of 1/4 inch (6 mm) between deck supports.
  3. Hydraulic system failures, including failure of hydraulic seals and cylinders.
  4. Faulty operation of operators, control system, or hardware.
- B. Warranty Period: Two years from date of Substantial Completion.
1. Warranty shall be for unlimited usage of the leveler for the specified rated capacity over the term of the warranty.

## **1.7 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of dock equipment Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.
1. Perform maintenance, including emergency callback service, during normal working hours.
- B. Continuing Maintenance Service: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other available manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

Rite Hite mechanical dock leveler 11160. Recessed adjustable dock leveler shall be 7' wide, 8' long. Unit to have an operational range of 12" above and below dock level. Equip each unit with two (2), 12" high x 4" deep molded dock bumpers.

### **2.2 MATERIALS, GENERAL**

- A. Source Limitations: Obtain each loading dock equipment component as a complete unit from one source and by a single manufacturer.

### **2.3 DOCK BUMPERS**

- A. Laminated-Tread Bumpers: Provide units of size indicated, fabricated from multiple plies cut from fabric-reinforced rubber tires to a uniform thickness of 4-1/2 in (112 mm). Laminate plies under pressure on 3/4 in (19 mm) diameter, steel supporting rods that are welded and bolted to 1/4 in (6 mm) thick, structural-steel angle closures with predrilled anchor holes. Size angles to provide not less than 1 in (25 mm) of tread plies extending beyond the face of closure angles.

- 1. Height: 10 in (250 mm) unless otherwise indicated.
- 2. Length: 36 in (900 mm) unless otherwise indicated.

- B. Anchorage Devices: Provide anchor bolts, nuts, washers, bolts, sleeves, cast-in-place plate, and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Hot-dip galvanize anchorage components.

- C. Manufacturers:

- 1. Blue Giant Equipment Corporation
- 2. Kelley
- 3. McGuire
- 4. Pioneer Loading Dock Equipment
- 5. Poweramp Systems, Inc.
- 6. Rite-Hite Corporation
- 7. Serco

### **2.4 RECESSED DOCK LEVELERS**

- A. General: Provide recessed dock levelers of type, function, operation, capacity, size, and construction indicated, complete with controls, safety devices, and accessories required.
- B. Type: Provide recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits, preformed in the edge of loading platform.

- C. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform in the following manner:
1. Vertical Travel: Minimum working range shall be 12 in (300 mm) above and 12 in (300 mm) below adjoining platform level. Provide an operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact.
  2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
  3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 in (100 mm) over width of ramp.
  4. Lip Operation: Provide manufacturer's standard mechanism that automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck, and automatically retracts lip when truck departs.
    - a. Length of Lip Extension: Not less than 16 in (400 mm) from ramp edge and not less than 12 in (300 mm) in front of dock bumpers.
  5. Automatic Ramp Return: Provide automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.
- D. Operation: Provide manufacturer's standard operating system as follows:
1. Hydraulic Operating System: Provide electric hydraulic raising and hydraulic lowering of ramp, controlled from a remotely located push-button station. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 in (75 mm).
    - a. Electrical Requirements: Coordinate wiring requirements and current characteristics with building electrical system. See Division 26 Sections.
    - b. Remote-Control Station: Provide a multibutton control station with an up button of the constant-pressure type and an emergency stop button of the momentary-contact type, enclosed in a NEMA ICS 6, Type 12 box. Raise ramp by holding up button depressed, and lower ramp at a controlled rate by releasing up button. Stop all ramp movement, regardless of position of ramp or lip, by depressing stop button. Resume normal operation by a manual reset button or by pulling out stop button.
    - c. Hydraulic Lip Operation: Provide electric-powered hydraulic raising and hydraulic lowering of lip, controlled independently of raising and lowering of ramp.
- E. Rated Capacity: Provide dock levelers capable of supporting a total gross load indicated below without permanent deflection or distortion, as determined by actual tests complying with requirements of MH 30.1 for rated capacity.
1. Total Load: Not less than 25,000 lb (11,350 kg).
- F. Safety Devices: Provide manufacturer's standard and optional safety devices as follows:
1. Toe Guards: Equip open sides of rising ramp over entire upper operating range with metal toe guards mounted flush with ramp edges and projecting below ramp.

2. Cross-Traffic Support: Provide manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
  3. Maintenance Strut: Provide an integral strut to positively support ramp in up position during maintenance of dock leveler.
  4. Interlocks: Provide control interlocks between dock leveler and other dock equipment as follows:
    - a. Leveler to Truck-Restraint Interlock: Leveler will not operate while truck restraint is not engaged.
- G. Construction: Fabricate dock-leveler frame from structural- and formed-steel shapes. Fabricate platform, including hinged lip, from nonskid steel plate. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles. Include two dock bumpers attached to frame.
- H. Finish and Color: Manufacturer's standard paint applied to factory-assembled and -tested dock levelers before shipping. Paint toe guards yellow to comply with ANSI Z535.1, and paint remainder of surfaces in manufacturer's standard color.
- I. Manufacturers:
1. Blue Giant Equipment Corporation
  2. Kelley
  3. McGuire
  4. Pioneer Loading Dock Equipment
  5. Poweramp Systems, Inc.
  6. Rite-Hite Corporation
  7. Serco

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrate surfaces to receive loading dock equipment and associated work and conditions under which work will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Starting work within a particular area will be construed as applicator's acceptance of surface conditions.
- B. Examine roughing-in for electrical systems for dock equipment to verify actual locations of connections before installation.
- C. Examine walls and floors of pits for suitable conditions where recessed dock equipment is to be installed. Pits shall be plumb and square, and properly sloped for drainage from back to front of dock.

### **3.2 PREPARATION**

- A. General: Coordinate installation of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.
- B. Clean recessed pits of debris.



### **3.3 INSTALLATION, GENERAL**

- A. General: Comply with manufacturer's detailed written instructions for installing loading dock equipment.
  - 1. Install equipment, motor, pump, control stations and wiring, safety devices, and accessories as required for a complete installation.
- B. Electrical Connections: Rough-in electrical connections according to requirements in Division 26.

### **3.4 DOCK-BUMPER INSTALLATION**

- A. Attach dock bumpers to structure in a manner that complies with requirements indicated for spacing, arrangement, and position relative to top of platform and anchorage.
  - 1. Bolted Attachment: Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or threaded studs welded to embedded steel plates or angles. If preset anchor bolts, cast-in-place inserts, or threaded studs welded to embedded plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.

### **3.5 DOCK LEVELER INSTALLATION**

- A. Attach leveler securely to loading platform construction according to manufacturer's written instructions, flush with adjacent dock surfaces and square to recessed pit.
- B. Recessed Dock Levelers: Coordinate forming recessed pit for dock levelers to ensure that recess is adequate to accommodate leveler in proper relation to loading platform.

### **3.6 CLEANING AND PROTECTING**

- A. Restore marred, abraded surfaces to their original condition.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure loading dock equipment is without damage or deterioration at the time of Substantial Completion.

### **3.7 DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
  - 3. Review data in maintenance manuals. Refer to Division 01 Section "Closeout Procedures."
  - 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION**

## SECTION 12 2413

### ROLLER WINDOW SHADES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Roller window shades and supplementary items necessary to complete their installation.
  - 1. Manually operated roller shades.
  - 2. Motor-operated roller shades.
- B. Related Requirements:
  - 1. Motorized Units: Division 26 Sections for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
  - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of roller shade.
  - 1. Shadeband Material: Not less than 10 in (250 mm) square. Mark inside face of material if applicable.
  - 2. Roller Shade: Full-size operating unit, not less than 16 in (400 mm) wide by 36 in (900 mm) long for each type of roller shade indicated.
  - 3. Installation Accessories: Full-size unit, not less than 10 in (250 mm) long.
- D. Roller-Shade Schedule: Use same designations indicated on Drawings.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.

- B. Product Test Reports: For each type of shadeband material, written reports based on evaluation of comprehensive tests performed by qualified testing agency indicating that each product complies with requirements.
- C. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- E. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For roller shades to include in maintenance manuals.
  - 1. Methods for maintaining roller window shades and finishes.
  - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
  - 3. Operating hardware.
  - 4. Motorized shade operator.

#### **1.5 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. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed, but not fewer than 2 units.

#### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.
- B. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up using materials indicated for the completed Work.
  - 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.

- a. Show typical components, attachments to building structure, and requirements of installation.
2. Notify Architect seven days in advance of the dates and times when mock-up will be installed.
3. Obtain Architect's acceptance of mock-ups before starting fabrication or installation.
4. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor and accepted by Architect in writing.
5. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

## **1.7 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer/fabricator's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document Requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.
    - f. Resolve deviations or differences between Contract Documents and the manufacturer/fabricator's specifications.
  3. Record discussions, including decisions and agreements reached and prepare report.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## 1.10 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## 1.11 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  - 1. Coverage of warranty includes but is not limited to the following:
    - a. Fabric failure includes deterioration, sag, warp, fade or will not remain fit for use.
  - 2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for the following periods from date of Substantial Completion
    - a. Manual operating components: 10 years.
    - b. Shade Cloth: 10 years.
    - c. Motors and electronic components: 5 years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  - 1. Draper Inc.
  - 2. Hunter Douglas Contract.
  - 3. Lutron Electronics Co., Inc.
  - 4. Mariak Contract
  - 5. MechoShade Systems, Inc.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
  - 1. Manufacturer and Product: As scheduled or as indicated in Design Selections.

### 2.2 MATERIALS, GENERAL

- A. Single Source Responsibility: Furnish each type of product from single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

### 2.3 SHADE SCHEDULE

- A. WS-1, WS-2: Refer to Interior Finish Legend

## 2.4 MANUALLY OPERATED SHADES

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Bead Chains: Manufacturer's standard, Stainless steel.
    - a. Loop Length: Full length of roller shade, unless otherwise indicated.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Clip, Chain tensioner and mounting as selected by Architect.
  2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
    - a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criteria are more stringent.
- B. Rollers - Single: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: As indicated on Drawings.
  2. Direction of Shadeband Roll: Regular, from back of roller, unless otherwise indicated.
  3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- C. Rollers - Double: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under, unless otherwise indicated.
  2. Inside Roller:
    - a. Drive-End Location: As indicated on Drawings.
    - b. Direction of Shadeband Roll: Regular, from back of roller.
  3. Outside Roller:
    - a. Drive-End Location: As indicated on Drawings.
    - b. Direction of Shadeband Roll: Reverse, from front of roller
  4. Shadeband-to-Roller Attachment: Manufacturer's standard method.

## 2.5 MOTOR-OPERATED

- A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.
    - a. Electrical Characteristics: Single phase, 110 V, 60 Hz, unless recommended otherwise by manufacturer.
  3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
    - a. Individual Switch Control Station: Momentary-contact, three -position, rocker-style, wall-switch-operated control station with open, close, and center off functions.
    - b. Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
    - c. Individual/Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
    - d. Color: As selected by Architect from manufacturer's full range.
  4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
  5. Operating Features:
    - a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
    - b. Capable of interface with audiovisual control system.
    - c. Override switch, if applicable.
- B. Rollers - Single: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: As indicated on Drawings.
  2. Direction of Shadeband Roll: Regular, from back of roller, unless otherwise indicated.
  3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- C. Rollers - Double: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Double-Roller Mounting Configuration: Offset, outside roller over and inside roller under, unless otherwise indicated.
  2. Inside Roller:
    - a. Drive-End Location: As indicated on Drawings.
    - b. Direction of Shadeband Roll: Regular, from back of roller.
  3. Outside Roller:
    - a. Drive-End Location: As indicated on Drawings.
    - b. Direction of Shadeband Roll: Reverse, from front of roller

4. Shadeband-to-Roller Attachment: Manufacturer's standard method.

## **2.6 SHADEBANDS AND ACCESSORIES**

- A. Shadebands – Single Roller:
  1. Shadeband Material: Refer to Shade Schedule for type. Color as scheduled or as indicated in Design Selections.
  2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material, unless otherwise indicated.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.
- B. Inside Shadebands – Double Roller:
  1. Shadeband Material: Refer to Shade Schedule for type. Color as scheduled or indicated in Design Selections.
  2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material
    - b. Color and Finish: As selected by Architect from manufacturer's full range
- C. Outside Shadebands – Double Roller:
  1. Shadeband Material: Refer to Shade Schedule for type. Color as scheduled or indicated in Design Selections.
  2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Exposed with endcaps and integral light seal with bottom (sill) channels.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.
- D. Installation Accessories:
  1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
    - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 4 in (100 mm).
  2. Endcap Covers: To cover exposed endcaps.
  3. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
  4. Installation Accessories Color and Finish: As selected from manufacturer's full range.
- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.
- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.



## **2.7 SHADEBAND MATERIALS**

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Shade Band Material: Manufacturer's standard PVC-free shade band material.

## **2.8 ROLLER-SHADE FABRICATION**

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
  - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 in (6 mm) per side or 1/2 in (12 mm) total, plus or minus 1/8 in (3 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 in (6 mm), plus or minus 1/8 in (3 mm).
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
  - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material. Obtain approved locations from Architect prior to fabrication.
  - 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

### **3.3 ROLLER-SHADE INSTALLATION**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. Respective manufacturer/fabricator's written installation instructions.
  2. Accepted submittals.
  3. Contract Documents.
- B. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
1. Opaque Shadebands: Located so shadeband is not closer than 2 in (50 mm) to interior face of glass. Allow clearances for window operation hardware.
- C. Electrical Connections: Connect motor-operated roller shades to building electrical system.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Manufacturer's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.

### **3.5 ADJUSTING**

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### **3.6 CLEANING AND PROTECTION**

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

### **3.7 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

### **3.8 FINISH SCHEDULE**

- A. See Interior Finish Legend on drawings.

**END OF SECTION**



## SECTION 12 3661

### SIMULATED STONE COUNTERTOPS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: The following simulated stone countertops along with supplementary items necessary for installation:
  - 1. Solid surfacing countertops.
  - 2. Quartz agglomerate countertops.
  - 3. Cultured marble countertops.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
- B. Shop Drawings: Show details of fabrication and installation, including plans, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work. Show locations and sizes of cutouts and holes for plumbing fixtures, accessories and other items installed in countertops.
- C. Samples for Verification Purposes: For simulated stone material, 6 in (150 mm) square, showing color and pattern selected.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

##### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with not less than 5 years of experience in the successful production and in-service performance of products and systems similar to scope of this Project.

##### 1.5 PRE-INSTALLATION CONFERENCE

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.

##### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

- B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication.

## 1.7 COORDINATION

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

## 1.8 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

- 1. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 10 years from date of Substantial Completion

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

- 1. Solid Surfacing Paneling.
  - a. Avonite Surfaces
  - b. E. I. du Pont de Nemours and Company
  - c. Formica Corporation
  - d. LG Chemical, Ltd.
  - e. Meganite Inc.
  - f. Samsung Chemical USA, Inc.
  - g. Swan Corporation (The)
  - h. Transolid, Inc.
  - i. Wilsonart International

- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

- 1. Color(s): As scheduled or as indicated in Interior Finish Schedule on drawings.

### 2.2 SIMULATED STONE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogenous solid sheets of filled plastic resin complying with ANSI SS1.
- B. Panel Thickness: Minimum 1/2 in (12 mm) or as indicated on drawings.

## **2.3 ACCESSORIES**

- A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded and other requirements as specified in Division 06 Section "Miscellaneous Rough Carpentry".
- B. Adhesives: Manufacturers recommended adhesive.
  - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Not more than 250 g/L.
- C. Lavatory Bowls: Provide one or both types below, as indicated on drawings:
  - 1. Under-slung or Self-Rimming Lavatory Bowls: Where indicated, provide as specified in Division 22 Plumbing Sections.
- D. Backsplash: Preformed 4 in (100 mm) high coved backsplash, to match countertop.
- E. Front Edge Trim: Preformed 1-1/2 in (38 mm), to match countertops.
- F. Accessories: Provide joint seam adhesives and other items required for a complete installation as recommended in writing by simulated stone manufacturer.
- G. Sealant: Mildew resistant silicone sealant as specified in Division 07 Section "Joint Sealants".

## **2.4 FABRICATION OF SIMULATED STONE COUNTERTOPS**

- A. Accurately cut holes and drill countertop panels to receive plumbing, fixtures, soap dispensers and other accessories. Obtain field measurements prior to fabrication and maintain minimum clearance at walls.
- B. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with simulated stone manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

### **3.2 INSTALLATION, GENERAL**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.

3. Contract Documents.

**3.3 PREPARATION**

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

**3.4 CONSTRUCTION TOLERANCES**

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/16 in per 48 in (1.5 mm per 1200 mm).
- B. Variation from Level: Do not exceed 1/8 in per 96 in (3 mm per 2400 mm), 1/4 in (6 mm) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/4 of nominal joint width.
- D. Variation in Plane at Joints (Lipping): Do not exceed 1/64 in (0.4 mm) difference between planes of adjacent units.
- E. Variation in Line of Edge at Joints (Lipping): Do not exceed 1/64 in (0.4 mm) difference between edges of adjacent units, where edge line continues across joint.

**3.5 INSTALLATION OF SIMULATED STONE COUNTERTOPS**

- A. Install countertops over plywood sub-tops secured to sub-framing supports with full spread of silicone adhesive in accordance with manufacturer's recommendations.
- B. Set countertops to comply with requirements indicated on Drawings and Shop Drawings. Shim and adjust to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- C. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
- D. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Secure backsplashes to tops and walls with adhesive.
- F. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants".
- G. Prepare ends and edges of simulated stone pieces to be joined according to the manufacturer's/fabricator's recommendations for position and angle of butted joint. Lightly sand and thoroughly clean to remove dirt and grease. Join pieces with adhesive clamped until fully cured. Buff and sand to produce a smooth uniform seamless surface.
- H. Apply sealant and compress to form bond with simulated stone material and adjacent surfaces and tool sealant surface to clean, straight lines.

**3.6 CLEANING**

- A. Promptly clean simulated stone as work progresses to minimize final cleaning. Do not leave adhesive or sealant to dry on simulated stone faces.
- B. Final clean and protect installed countertops in accordance with manufacturer's instructions.

**3.7 FINISH SCHEDULE**

- A. Color: As shown in Interior Finish Schedule on drawings.

**END OF SECTION**





## SECTION 14 2100

### ELECTRIC TRACTION ELEVATORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Pre-engineered electric traction passenger elevators and supplementary items necessary to complete their installation.
  - 1. Designated elevator complying with code requirements for stretcher.
- B. Related Requirements: Including but not limited to the following:
  - 1. Division 05 Section "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.
  - 2. Division 05 Section "Metal Fabrications" for the following:
    - a. Pit ladders.

##### 1.2 PRODUCT VARIATIONS AND ADJUSTMENTS

- A. Product Variations: In the event of differences between products and systems of acceptable or available manufacturer/fabricators, Contractor shall notify Architect of such differences and resolve conflicts prior to awarding Contract. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
- B. Adjustments: Proposed deviations shall include a detailed analysis of impact to adjacent substrates, structural, mechanical, electrical or other building systems, including related design or construction cost impacts. Deviations causing changes in materials, constructability, substrates, systems or conditions shall be included in the Work at no additional cost to Owner.

##### 1.3 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.
- C. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

## 1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical literature for each product and system indicated.
  - 1. Include manufacturer's specifications for materials, finishes, construction details, installation instructions, and recommendations for maintenance.
  - 2. Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components and attachments to other work. Distinguish between shop and field-assembled work.
  - 1. Include large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
    - a. Include machine room layout if applicable.
    - b. Include large-scale layout of car-control station.
    - c. Include standby power operation control panel if applicable.
  - 2. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
  - 3. Indicate variations from specified requirements.
- C. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3 inch (75 mm) square Samples of sheet materials; and 4 inch (100 mm) lengths of running trim members.
  - 1. Signal and Fixtures: Architect shall select and approve all fixture selections.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room or control closet layout and dimensions, as shown on Drawings, and electrical service including standby power generator if applicable, as shown and specified, are adequate for elevator system being provided.
- C. Field Quality Control Reports: Written report of testing and inspection required by "Field Quality Control".
- D. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.

- E. Warranty: Sample of warranty.
  - 1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- B. Diagnostic Test Equipment and Instructions: Provide all diagnostic test devices together with one set of all supporting information necessary for interpretation of test data and troubleshooting of system. The elevator installation shall be a design that can be maintainable by any licensed elevator maintenance company employing journeymen mechanics, without the need to purchase or lease additional diagnostic devices, special tools, or instructions from the original equipment manufacturer.
- C. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

## **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Experience: Installer's personnel with not less than 5 years of experience in the successful performance of Work similar to scope of this Project.
  - 2. Supervision: Installer shall maintain a competent supervisor at Project while the Work is in progress, and who has not less than 5 years of experience installing products and systems similar to scope of this Project.
  - 3. Manufacturer Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer to install products.

## **1.8 PRE-INSTALLATION CONFERENCE**

- A. Pre-Installation Conference: Before Work begins, conduct conference at Project site.
  - 1. Participants:
    - a. Architect.
    - b. Contractor, including superintendent.
    - c. Installer, including project manager and supervisor.
    - d. If requested, Manufacturer's qualified technical representative.
    - e. Installers of other construction interfaced with Work.
  - 2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:
    - a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
    - b. Review Contract Document requirements.
    - c. Review approved submittals.
    - d. Review inspection and testing requirements.
    - e. Review environmental conditions and procedures for coping with unfavorable conditions.

- f. Resolve deviations or differences between Contract Documents and the manufacturer's specifications.
3. Record discussions, including decisions and agreements, and prepare report.

## **1.9 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.

## **1.10 COORDINATION**

- A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.
- B. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- C. Coordinate locations and dimensions of other work relating 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, pits, and machine rooms.

## **1.11 WARRANTY**

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
  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: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 1 year from date of Substantial Completion.

## **1.12 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled employees of the elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.
  1. Service Records: Installer shall provide a report of all service calls, maintenance service and repairs made during the initial maintenance service period.
  2. Perform maintenance, including emergency callback service, during normal working hours with two hour or less response time.
  3. Include 24-hour-per-day, 7-day-per-week emergency callback service with one hour or less response time.

- B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
- C. Parts: Contractor guarantees to sell parts, including circuit boards, to the Owner or Owner's Agent.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS AND PRODUCTS**

- A. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".
  - 1. KONE Inc.
  - 2. Otis Elevator Co.
  - 3. Schindler Elevator Corp.
  - 4. ThyssenKrupp Elevator.
- B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.
  - 1. Manufacturer and Product: KONE Monospace 500

**2.2 MATERIALS, GENERAL**

- A. Source Limitations: Obtain elevators, including hydraulic passenger elevators when specified in another Section, 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.

**2.3 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable provisions of ASME A17.1/CSA B44 "Safety Code for Elevators and Escalators".
- B. Accessibility Requirements: Comply with requirements of authorities having jurisdiction and Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to the building code and shall comply with elevator safety requirements for applicable seismic risk Zone 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 and the system will be fully operational after the seismic event."

## 2.4 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 – Passenger Elevator, No 1:
1. Machine Location:
    - a. Hoistway; no machine room is provided.
  2. Machine Type:
    - a. Traction; Geared for speeds up to 450 fpm; Gearless for speeds of 500 fpm and higher.
  3. Rated Load: 2500 lb (1135 kg).
  4. Rated Speed: 150 fpm
  5. Operation System: Microprocessor operation, VVVF control.
  6. Auxiliary Operations:
    - a. Standby power operation.
    - b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44
    - c. Automatic dispatching of loaded car.
    - d. Nuisance call cancel.
    - e. Emergency hospital service at all floors.
    - f. Independent service for service elevator and all cars in group.
    - g. Loaded-car bypass.
    - h. Distributed parking.
  7. Dual Car-Control Stations: Provide two car-control stations in each elevator; equip only one with required keyswitches if any.
  8. Car Enclosures:
    - a. As indicated on Drawings.
    - b. Inside Width: Unless otherwise indicated, Manufacturer's standard for rated load; measured from side wall to side wall.
    - c. Inside Depth: Unless otherwise indicated, Manufacturer's standard for rated load; measured from back wall to front wall (return panels).
    - d. Inside Height: Unless otherwise indicated, 108 inches (2700 mm) measured to underside of ceiling
    - e. Front Walls (Return Panels) and Car Fixtures:
      - 1) **Satin stainless steel, No. 4 finish**
    - f. Side and Rear Wall Panels and Reveals:
      - 1) **Satin stainless steel, No. 4 finish**
    - g. Door Faces (Interior):
      - 1) **Satin stainless steel, No. 4 finish**
    - h. Door Sills:
      - 1) Nickel silver
    - i. Ceiling:
      - 1) **Satin stainless steel, No. 4 finish**

- j. Handrails: Unless otherwise indicated, at rear of car.
  - 1) Satin stainless steel, No. 4 finish

9. Hoistway Entrances: Refer to drawings

- a. Sills at First Floor:
  - 1) Nickel silver, polished
- b. Sills at Other Floors:
  - 1) Bronze, polished
  - 2) Nickel silver, polished
- c. Doors and Frames at First Floor:
  - 1) Satin stainless steel, No. 4 finish
- d. Doors and Frames at Other Floors:
  - 1) Satin stainless steel, No. 4 finish
  - 2) Textured stainless steel at doors

10. Hall Fixtures: Refer to Drawings

11. Additional Requirements:

- a. Provide inspection certificate in each car, mounted under acrylic cover with frame matching adjacent metal finish.
- b. Provide hooks for protective pads in all cars and two complete set(s) of full-height protective pads.

**C. Elevator Description – Service Elevator, No 2:**

- 1. Machine Location:
  - a. Hoistway; no machine room is provided.
- 2. Machine Type:
  - a. Traction; Geared for speeds up to 450 fpm; Gearless for speeds of 500 fpm and higher.
- 3. Rated Load: 5000 lb (2270 kg).
- 4. Rated Speed: 150 fpm
- 5. Operation System: Microprocessor operation, VVVF control.
- 6. Auxiliary Operations:
  - a. Standby power operation.
  - b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
  - c. Automatic dispatching of loaded car.
  - d. Nuisance call cancel.
  - e. Emergency hospital service at all floors.
  - f. Independent service for service elevator and all cars in group.
  - g. Loaded-car bypass.
  - h. Distributed parking.



7. Dual Car-Control Stations: Provide two car-control stations in each elevator; equip only one with required keyswitches if any.
8. Car Enclosures:
  - a. As indicated on Drawings.
  - b. Inside Width: Unless otherwise indicated, Manufacturer's standard for rated load; measured from side wall to side wall.
  - c. Inside Depth: Unless otherwise indicated, Manufacturer's standard for rated load; measured from back wall to front wall (return panels).
  - d. Inside Height: Unless otherwise indicated, 108 inches (2700 mm) measured to underside of ceiling
  - e. Front Walls (Return Panels) and Car Fixtures:
    - 1) Satin stainless steel, No. 4 finish
  - f. Side and Rear Wall Panels and Reveals:
    - 1) Satin stainless steel, No. 4 finish
  - g. Door Faces (Interior):
    - 1) Satin stainless steel, No. 4 finish
  - h. Ceiling:
    - 1) Satin stainless steel, No. 4 finish
  - i. Handrails: Unless otherwise indicated, at rear of car.
    - 1) Satin stainless steel, No. 4 finish
  - j. Door Sills:
    - 1) Nickel silver
9. Hoistway Entrances: Refer to Drawings
  - a. Doors and Frames at First Floor:
    - 1) Satin stainless steel, No. 4 finish
  - b. Doors and Frames at Other Floors:
    - 1) Satin stainless steel, No. 4 finish
  - c. Sills at First Floor:
    - 1) Nickel silver, polished
  - d. Sills at Other Floors:
    - 1) Nickel silver, polished
10. Hall Fixtures: Refer to Drawings
11. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame matching adjacent metal finish.
  - b. Provide hooks for protective pads in all cars and two complete set(s) of full-height protective pads.

D. Elevator Description – Passenger Elevator, No. 3:

- a. Machine room above hoistway

- b. Hoistway; no machine room is provided.
2. Machine Type:
    - a. Traction; Geared for speeds up to 450 fpm; Gearless for speeds of 500 fpm and higher.
  3. Rated Load: 2500 lb (1135 kg).
  4. Rated Speed 150 fpm
  5. Operation System: Microprocessor operation, VVVF control.
  6. Auxiliary Operations:
    - a. Standby power operation.
    - b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
    - c. Automatic dispatching of loaded car.
    - d. Nuisance call cancel.
    - e. Emergency hospital service at all floors.
    - f. Independent service for service elevator and all cars in group.
    - g. Loaded-car bypass.
    - h. Distributed parking.
  7. Dual Car-Control Stations: Provide two car-control stations in each elevator; equip only one with required keyswitches if any.
  8. Car Enclosures:
    - a. As indicated on Drawings.
    - b. Inside Width: Unless otherwise indicated, Manufacturer's standard for rated load; measured from side wall to side wall.
    - c. Inside Depth: Unless otherwise indicated, Manufacturer's standard for rated load; measured from back wall to front wall (return panels).
    - d. Inside Height: Unless otherwise indicated, 108 inches (2700 mm) measured to underside of ceiling
    - a. Front Walls (Return Panels) and Car Fixtures:
      - 1) Satin stainless steel, No. 4 finish
    - b. Side and Rear Wall Panels and Reveals:
      - 1) Satin stainless steel, No. 4 finish
    - c. Door Faces (Interior):
      - 1) Satin stainless steel, No. 4 finish
    - d. Door Sills:
      - 1) Nickel silver
    - e. Ceiling:
      - 1) Satin stainless steel, No. 4 finish
    - f. Handrails: Unless otherwise indicated, at rear of car.
      - 1) Satin stainless steel, No. 4 finish
  2. Hoistway Entrances: As indicated on Drawings
    - a. Doors and Frames at First Floor:
      - 1) Satin stainless steel, No. 4 finish

- b. Doors and Frames at Other Floors:
  - 1) Satin stainless steel, No. 4 finish
- c. Sills at First Floor:
  - 1) Nickel silver, polished
- d. Sills at Other Floors:
  - 1) Nickel silver, polished
- 3. Hall Fixtures: Refer to Drawings
- 4. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame matching adjacent metal finish.
  - b. Provide hooks for protective pads in all cars and two complete set(s) of full-height protective pads.

## 1.2 TRACTION SYSTEMS

- A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
  - 1. Provide non-regenerative system.
- B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide framing as indicated in Drawings to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Structural Steel Framing" for materials and fabrication.
- E. Hoist Beams: Provide framing as indicated in Drawings to support elevator installation. Comply with Division 05 Section "Structural Steel Framing" for materials and fabrication.
- F. Car Frame and Platform: Welded-steel units.
- G. Guides: Provide guides at top and bottom of car and counterweight frames.
- H. Guide Rails: Provide guide rails of structural capacity required to span between available structural supports without additional secondary steel, unless indicated otherwise on Drawings.

## 1.3 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

- B. Group Automatic Operation with Demand-Based Dispatching for Groups of Three or More Cars: Provide reprogrammable group automatic system that assigns cars to hall calls based on a dispatching program designed to minimize passenger waiting time and time to destination. System automatically adjusts to demand changes for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. KONE Inc.; KCM 831.
    - b. Otis Elevator Co.; Elevonic.
    - c. Schindler Elevator Corp.; Miconic TX.
    - d. ThyssenKrupp Elevator, Traflomatic.
- C. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
1. Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. One car is returned at a time, with priority given to loaded cars. If a car cannot be returned, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within a predetermined time, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby or fire command station as indicated. Manual operation causes automatic operation to cease.
  2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
  3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
  4. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
  5. Distributed Parking: When cars are not required for response to calls, they are parked with doors closed and distributed in predetermined zones throughout the building. One zone shall include the main floor and adjacent floors; remaining floors shall be divided into approximately equal zones.
  6. Independent Service: Keyswitch in car-control station removes car from group operation and allows it to respond only to car calls. Key cannot be removed from keyswitch when car is in independent service. When in independent service, doors close only in response to door close button.
  7. Emergency Hospital Service: Service is initiated by card reader at designated floors. One elevator is removed from group operation and directed to the floor where service was initiated. On arriving at the floor, elevator opens its doors and parks. Car is placed in operation by selecting a floor and pressing door close button. After responding to floor selected, car is returned to group operation. If car is not placed in operation within a preset time after being called, it is returned to group operation.
  8. Special Emergency Control – Firefighter’s Service: Provide Phase I and Phase II Firefighters’ Service; comply with requirements of authorities having jurisdiction and applicable provisions of ASME A17.1/CSA B44 "Safety Code for Elevators and Escalators".

- a. Firefighters Emergency Operation – Phase I Emergency Recall: The activation of a key switch at the designated level hall station shall express return all cars in the group to the designated floor and by-pass all car and hall calls. The cars shall park at the designated floor with the doors open and will not respond to car or hall calls unless the Phase II switch in the car is activated.
  - b. Firefighters Emergency Operation - Phase II: In-car key switch control of each elevator during the Emergency operation.
  
- D. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
  - 1. Card-Reader Operation: System uses card readers at car-control stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Allow space as indicated for card reader in car.
    - a. Coordinate requirements with Security access system equipment specified in "Access Control" unless otherwise indicated.
  - 2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car or all cars in a group to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.
  
- E. Electrical Wiring:
  - 1. Furnish and install complete insulated wiring to connect all parts of the equipment. Properly ground all components as required by National Electric Code.
  - 2. Provide 15% spare wires between each controller, selector, hoistway junction box, and control panel; also provide 15% spare conductors in each trail cable; all spares shall be properly tagged or otherwise identified with clear and indelible markings.
  - 3. Provide a total of twelve (12) shielded pairs for communication and security use in the traveling cables for each elevator. The shielded pairs shall be located in a cable which is not used to carry alternating current circuits. The shielded wiring shall extend to a junction box in the elevator controllers in machine room.

#### **1.4 DOOR REOPENING DEVICES**

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

#### **1.5 CAR ENCLOSURES**

- A. General: Provide enameled-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.

2. Elevator Car Allowance: Provide items not included in the Elevator Car Allowance as needed for finished car.
  - a. Car platform sling, shell, canopy, door, door frame and return panel, shall not be included as a part of this allowance.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor for Carpet or Resilient Flooring: Exterior, underlayment grade plywood, not less than 5/8 inch (15 mm) nominal thickness.
2. Subfloor for Tile or Stone: Exterior, C-C Plugged grade plywood, not less than 7/8 inch (21 mm) nominal thickness.
3. Floor Finish: As scheduled, or as indicated in "Design Selections"; match sample accepted by Architect.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
- ~~6. ning.~~
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded metal, with grooved surface, 1/4 inch (6 mm) thick.
- ~~9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.~~
10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.
11. Emergency Exits: Provide emergency exits sized and located in each car in accordance with the Elevator Code.

## 1.6 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Protection Rating: 1-1/2 hours.

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Frames: Not less than 14 gauge.
2. Doors: Not less than 16 gauge.
3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (75 mm) high, on both inside surfaces of hoistway door frames.
4. Entrance Jamb Plates: Cast metal plates complying with Elevator Code and Accessibility requirements.
5. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
6. Sight Guards: Provide sight guards on doors matching door edges.
7. Sills: Extruded metal, with grooved surface, 1/4 inch (6 mm) thick.

8. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.
- D. Architecturally Exposed Hoistways: For hoistway equipment exposed to public view, provide finishes as selected by Architect.

## **1.7 SIGNAL EQUIPMENT**

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers or LEDs.
- B. Swing-Return Car-Control Stations: Provide car-control stations mounted on hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
1. Unless indicated otherwise, include manufacturer's premium fixture selection and provide full width swing front return and car operating panels. Logos or manufacturer's name are not permitted on exposed surfaces.
  2. Mark buttons and switches for function. Use both tactile symbols and Braille.
  3. 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.
  4. Mount controls at heights complying with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)."
  5. Provide two car control stations in each passenger elevator; equip only one with required keyswitches.
  6. Provide two car control stations in each elevator with front and rear doors; locating one station at each door; equip only one with required keyswitches.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: If required by authorities having jurisdiction, provide flush-mounted cabinet or telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 "Fire-Alarm System."
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than two stations for each three elevators in a group.
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.
  3. Provide Firefighters Emergency Service – Phase I key switch in designated hall station.
  4. If required by authorities having jurisdiction, provide telephone jack in each unit for firefighters' two-way telephone communication service.

- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:
  - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
  - 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
- H. 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.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrances at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
- J. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- K. Emergency Pictorial Signs: Unless otherwise indicated, Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

## **1.8 FINISH MATERIALS**

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
  - 1. Car Shell: Not less than 14 gauge.
  - 2. Car Canopy: Not less than 12 gauge.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- E. Stainless-Steel Bars: ASTM A 276, Type 304.
- F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- I. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications, Type HGP for post-formed applications and Type BKV for panel backing.



## **PART 2 - EXECUTION**

### **2.1 EXAMINATION**

- A. Acceptance of Surfaces and Conditions: Examine substrates and areas to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.
- B. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

### **2.2 INSTALLATION**

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
  - 1. Respective manufacturer's written installation instructions.
  - 2. Accepted submittals.
  - 3. Contract Documents.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
  - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
  - 2. Place hall lanterns either above or beside each hoistway entrance, unless otherwise indicated.
  - 3. Mount hall lanterns at a minimum of 72 inches (1800 mm) above finished floor.

## **2.3 FIELD QUALITY CONTROL**

- A. Manufacturer/Fabricator's Field Service: Manufacturer/fabricator's qualified technical representative shall periodically inspect Work to ensure installation is proceeding in accordance with manufacturer/fabricator's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.
1. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with experience in providing recommendations, observations, evaluations, and problem diagnostics.
- B. 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.
- C. 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.
1. Provide operating test on one elevator of each type, capacity, speed, and travel distance.
  2. Damage to car or adjoining structure caused by performance testing shall be repaired or replaced at no cost to Owner.
- D. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

## **2.4 PROTECTION**

- A. Temporary Use: Temporary use of elevators for construction purposes is not allowed unless authorized by Owner. Comply with the following requirements for each elevator used for construction purposes:
1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  2. Provide strippable protective film on entrance and car doors and frames.
  3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
  4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  5. Do not load elevators beyond their rated weight capacity.
  6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.
    - a. Restore elevator sill(s) to new condition or replace with new sill(s).

## **2.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
  - 1. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program.
- B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

**END OF SECTION**

## SECTION 31 23 33 - TRENCHING

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Trenching, backfilling, and compacting for the installation of utility lines.

#### 1.2 DEFINITIONS

- A. Unclassified Excavation: Shall consist of the material excavated, including earth, shale, rock, gravel, debris or other material excavated or otherwise removed in the preparation of the trench and its handling, placement, or disposal.

#### 1.3 QUALITY ASSURANCE

- A. Failure Criteria: Not limited to the following:
  1. Settlement of backfill below natural ground surface.
  2. Evidence of leakage of the piping.
  3. Malfunctioning of buried electrical or piping systems.

#### 1.4 PROJECT AND SITE CONDITIONS

- A. Borrow Sources: Shall be as approved by the Engineer prior to excavation.
- B. Environmental Conditions:
  1. Excavate areas that have become saturated with oil, gasoline, or bituminous products to a depth of 12 inches (300 mm) beyond contaminated materials; backfill with approved material.
  2. Finish slopes according to the drawings. The final surface shall be similar to a surface obtained by using a farm disk or harrow parallel to the contours and shall blend with the adjacent terrain. Hand rake as necessary to remove excess material in areas inaccessible to construction equipment. Grade to produce a well-drained surface. Excess material from trench excavation shall be placed over the backfill in an inverted "U" shape, however it must not impede drainage.

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. General: Material excavated shall be considered unclassified.
- B. Backfill Material: When the type of backfill material to be placed above the standard bedding material is not indicated on the Drawings or specified, the backfill may be made with excavated material, provided that such material, in the opinion of the Engineer is suitable for backfill. In the event excavated material is not suitable, standard bedding material shall be used. Backfill material shall not contain ice or frozen earth, debris, or be of a high moisture content. Materials removed in clearing and grubbing shall not be used for backfill. Backfill shall not contain rock larger than 3 inches in diameter.
- C. Standard Bedding Material:
  1. Standard Bedding Material (SBM) shall meet the requirements of ASTM D-2321 or ASTM C12 for the class of materials described in this subsection.
    - Class I. Class I shall be an angular, ¼ in. to 1 ½ in. graded crushed stone.

Class II. Class II shall include coarse sands and gravels with maximum particle size of 1-1/2 in. These materials may have small percentages of fines, but shall be generally granular and non-cohesive, either wet or dry. Class II materials shall include Unified Soil Classification system Soil Types GW, GP, SW and SP.

Class III. Class III shall include fine sands, sand-clay mixtures and gravel-clay mixtures. USCS Soil Types GM, GC, SM and SC are included in this class.

- D. Sod Materials: Shall consist of the grass mat from a lawn or cultured grass area, which has sufficient root mat to remain together when rolled or removed from the trench area. Grass and soil, which will not reasonably remain intact, shall be considered topsoil.

### PART 3: EXECUTION

#### 3.1 PREPARATION

- A. Clearing: Provide minimum disturbance to existing grass and sod. Dispose of debris at a location off site. All debris to become the property of the Contractor.
- B. Topsoil: Strip topsoil, or in the absence of topsoil, strip the top 4 to 6 inches of surface material and store in stockpile areas. Do not excavate into the underlying, original topsoil at stockpiles. Place previously stripped topsoil onto disturbed-earth areas upon completion of the backfilling operation.
- C. Utilities: Before starting excavation, establish the location and extent of underground utilities in the work area. Protect active utility services uncovered by excavation. Notify the Engineer immediately if utilities are damaged. Damage to utilities shall be repaired or replaced at the Contractor's expense.
- D. Cutting Pavement, Curbs, and Gutters: Make cuts with parallel, straight lines, minimum of 1 foot wider than trench width on each side of trench or pit edge.
- E. Protection of Excavation: Construct and maintain shoring, bracing, underpinning, and sheet piling necessary to protect the excavation and adjacent structures.
- F. Dewatering: Keep the excavation dewatered so that pipe, forming, and concrete work can be carried on under dewatered conditions. Dispose of excess water in a manner that will avoid damage to adjacent property.

#### 3.2 INSTALLATION

- A. General:
  - 1. Restore disturbed areas of existing bituminous pavements.
  - 2. Restore disturbed areas of existing concrete structures.
- B. Trench Excavation: Shall be excavated so that pipe can be laid to the alignment and grades shown on the Drawings. Excavate trenches in rock to a depth of at least 4 inches, but not exceeding 12 inches, below pipe bottom. Depth is dependent upon type of pipe. See Details.
  - 1. When over-excavation occurs, repair the area by backfilling with approved bedding material and compacting to 95 percent maximum dry density according to AASHTO T 99, Method C.
  - 2. When frost action occurs, remove frozen soil and replace with approved soil compacted to 95% of maximum dry density as determined by AASHTO T 99, Method C.

3. When soil becomes saturated above the optimum moisture content, manipulate or dry the material to optimum moisture content and compact, or remove soil down to firm material and place backfill before construction proceeds.
- C. Removal of Materials by Explosives: The use of explosives is prohibited unless specifically authorized by OWNER and local authorities.
  - D. Standard Bedding Material (SBM): Shall be placed as shown on the drawings, carefully placed and compacted along the entire length of the pipe to be installed to the limits of trench excavation, until the thickness specified is obtained. Fine grade the trench bottom throughout and provide uniform and continuous support for each section of pipe or conduit except at bell holes or depressions necessary for making proper joints.
    1. Gravity Pipelines: Standard Bedding Material shall be placed simultaneously on each side of pipe and shall be carefully compacted in accordance with the specifications for the type of pipe to be installed.
      - a. Class I SBM requires little or no compaction due to the nature of the angular particles.
      - b. Class II SBM shall be compacted to a minimum of 85% Standard Proctor Density using hand or mechanical tamping methods.
      - c. Class III SBM shall be compacted to a minimum 90% Standard Proctor Density using hand or mechanical methods. Avoid above optimum moisture conditions.
    2. Pressure Pipelines: SBM shall be placed simultaneously on each side of pipe and compacted sufficiently to maintain proper grade and alignment.
  - E. Trench Backfill: Flooding of trench for consolidation of backfill will not be permitted.
    1. Place backfill to avoid damaging or moving the pipe. Place backfill in 6-inch maximum loose lifts to a depth of 1.5 foot over the top of the pipe. Backfill operations shall be completed within 100 ft. or less of the finished line at all times as directed by the Engineer. Provide compaction as required by specifications and material type.
  - F. Utility Line Marking: Shall be done according to Section 33 05 26 - Utility Line Marking.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Contractor shall furnish necessary equipment, labor, and materials to conduct the testing. Testing shall be conducted in the presence of the Inspector, who shall be given 48 hours notice before any test is to be conducted. Arrange for a certified, independent testing laboratory, according to the requirements of Section 01 45 29 - Testing Laboratory Services, to perform the required testing, recording, and distributing of the results.
- B. Testing of Pipe Lines: Shall be done according to Section 01 45 34 - Testing of Piping Systems.

END OF SECTION

## SECTION 31 41 34 - EXCAVATION, TRENCHING, & SHORING

### PART 1. GENERAL:

#### 1.1 DESCRIPTION:

- A. This section covers deep excavations and supporting systems for trenches to protect the safety of workers, provide suitable means for constructing sewer lines, and to protect public or private property, including existing utilities.
- B. Detailed designs for proposed shoring, etc. shall be submitted and designed by a registered professional engineer employed by the contractor for the architects review prior to starting work. The Owner, Architect, Architect's consultants and their agents and employees do not in any way assume responsibility for the shoring design to be utilized by the Contractor. Contractor shall assume the entire responsibility for all shoring, etc. and make good any damage caused by or due to improper supports or failure of shoring, etc. in any respect.

#### 1.2 EXISTING STRUCTURES:

- A. Where existing buildings, other utilities, streets, highways, or other structures are in close proximity to the trench, adequate protection shall be provided by the use of sheeting and shoring to protect the structure, street, or highway from possible damage. In the case of utilities, the Contractor may elect to remove the utility provided that the removal and subsequent replacement meets with the approval of the Architect, Engineer, the utility owner, or whoever has jurisdiction of the structure. In all cases, it shall be the responsibility of the Contractor to protect public and private property and any person or persons who might, as a result of the Contractor's work, be injured.

### PART 2. EXECUTION

#### 2.1 EXCAVATIONS, TRENCHING, AND SHORING:

- A. The Contractor shall include in his bid price and be solely responsible for trench safety provisions meeting the requirements of the United States Department of Labor Occupational Safety and Health Administration. The Contractor shall, as a minimum, provide trench safety provisions as shown on the plans and conforming to the following regulations, as contained in Subpart P, Part 1926 of the Code of Federal Regulations, shall be complied with along with all other applicable Subparts and Regulations not herein contained:
  - 1. Subpart P - Excavations, Trenching, and Shoring:
    - a. General Protection Requirements:
      - 1) Walkways, runways, and sidewalks shall be kept clear of excavated material or other obstructions and no sidewalks shall be undermined unless shored to carry a minimum live load of one hundred and twenty- five (125) pounds per square foot.
      - 2) If planks are used for raised walkways, runways, or sidewalks, they shall be laid parallel to the length of the walk and fastened together against displacement.
      - 3) Planks shall be uniform in thickness and all exposed ends shall be provided with beveled cleats to prevent tripping.
      - 4) Raised walkways, runways, and sidewalks shall be provided with plank steps on strong stringers. Ramps, used in lieu of steps, shall be provided with cleats to insure a safe walking surface.
      - 5) All employees shall be protected with personal protective equipment for the protection of the head, eyes, respiratory organs, hands, feet and other parts of the body as set forth in Subpart E. of this part.

- 6) Employees exposed to vehicular traffic shall be provided with and shall be instructed to wear warning vests marked with and made of reflectorized or high-visibility material.
  - 7) Employees subjected to hazardous dusts, gases, fumes, mists or atmospheres deficient in oxygen, shall be protected with approved respiratory protection as set forth in Subpart D of this part.
  - 8) No person shall be permitted under loads handled by power shovels, derricks, or hoists. To avoid any spillage employees shall be required to stand away from any vehicle being loaded.
  - 9) Daily inspections of excavations shall be made by a competent person. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees.
- b. Specific Excavation Requirements:
- 1) Prior to opening an excavation, effort shall be made to determine whether underground installations, i.e., sewer, telephone, water, fuel, electric lines, etc. will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such an installation, the exact locations shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.
  - 2) Trees, boulders and other surface encumbrances, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operation shall be removed or made safe before excavating is begun.
  - 3) The walls and faces of all excavations in which employees are exposed to danger from moving ground shall be guarded by a shoring system, sloping of the ground, or some other equivalent means.
  - 4) Excavations shall be inspected by a competent person after every rainstorm or other hazard-increasing occurrence and the protection against slides and cave-ins shall be increased if necessary.
  - 5) The determination of the angle of repose and design of the supporting system shall be based on careful evaluation of pertinent factors such as: Depth of cut, possible variation in water content of the material while the excavation is open; anticipated changes in materials from exposure to air, sun, water, or freezing; loading imposed by structured, equipment overlying material, or stored material; and vibration from equipment, blasting, traffic, or other sources.
  - 6) Supporting systems, i.e., piling, cribbing, shoring, etc. shall be designed by a qualified person and meet accepted engineering requirements. When tie rods are used to restrain the taping, sheeting or other retaining systems, the rods shall be securely anchored well back of the angle of repose. When tight sheeting or sheet piling is used, full loading due to ground water table shall be assumed, unless preventing by weep holes or drains or other means. Additional stringers, ties and bracing shall be provided to allow for any necessary temporary removal of individual supports.
  - 7) All slopes shall be excavated to at least the angle of repose except for areas where solid rock allows for line drilling or presplitting.
  - 8) The angle of repose shall be flattened when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action, and slide planes appear.
    - a) In excavations which employees may be required to enter, excavated or other material shall be effectively stored and retained at least 2 feet or more from the edge of the excavation.
    - b) As an alternative to the clearance prescribed in sub-paragraph (1) of this paragraph, the employer may use effective barriers or other effective retaining devices in lieu thereof in order to prevent excavated or other materials from falling into the excavation.



- 9) Sides, slopes, and faces of all excavations shall meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.
  - 10) Support systems shall be planned and designed by a qualified person when excavation is in excess of 20 feet in depth, adjacent to structures or improvements, or subject to vibration or ground water.
  - 11) Materials used for sheeting, sheet piling, cribbing, bracing, shoring, and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots, and of proper dimensions.
  - 12) Special precautions shall be taken in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or a fill, particularly when the separation is less than the depth of the excavation. Particular attention also shall be paid to joints and seams of materials comprising a face and the slope of such seams and joints.
  - 13) Except in hard rock, excavation below the level of the base of footing of any foundation or retaining wall shall not be permitted, unless the wall is underpinned and all other precautions taken to insure the stability of the adjacent walls for the protection of employees involved in excavation work or in the vicinity thereof.
  - 14) If the stability of adjoining buildings or walls is endangered by excavations, shoring, bracing, or underpinning shall be provided as necessary to insure their safety. Such shoring, bracing or underpinning shall be inspected daily or more often, as conditions warrant, by a competent person and the protection effectively maintained.
  - 15) Diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Water shall not be allowed to accumulate in an excavation.
  - 16) If it is necessary to place or operate power shovels, derricks, trucks, materials, or other heavy objects on a level above and near an excavation, the sides of the excavation shall be sheet-piled, shored, and braced as necessary to resist the extra pressure due to such superimposed loads.
  - 17) Blasting and the use of explosives shall be performed in accordance with Subpart U of this part.
  - 18) When mobile equipment is utilized or allowed adjacent to excavations, substantial stop logs or barricades shall be installed. If possible, the grade should be away from the excavation.
  - 19) Adequate barrier physical protection shall be provided at all remotely located excavations. All wells, pits shafts, etc. shall be barricaded or covered. Upon completion of exploration and similar operations, temporary wells, pits, shafts, etc. shall be backfilled.
  - 20) If possible, dust conditions shall be kept to a minimum by the use of water, salt, calcium chloride, oil or other means.
  - 21) In locations where oxygen deficiency or gaseous conditions are possible, air in the excavation shall be tested. Controls as set forth in Subpart d, D and E of this part, shall be established to assure acceptable atmospheric conditions. When flammable gases are present, adequate ventilation shall be provided or sources of ignition shall be eliminated. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, basket stretcher, etc. shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.
  - 22) Where employees or equipment are required or permitted to cross over excavations, walkways or bridges with standard guardrails shall be provided.
  - 23) Where ramps are used for employees or equipment, they shall be designed and constructed by qualified persons in accordance with accepted engineering requirements.
  - 24) All ladders used on excavation operations shall be in accordance with the requirements of Subpart L of this part.
- c. Specific Trenching Requirements:

- 1) Banks more than 5 feet high shall be shored, laid back to a stable slope, or some other equivalent means of protection shall be provided where employees may be exposed to moving ground or cave-ins. Refer to Table P-1 as a guide in sloping of banks. Trenches less than 5 feet in depth shall also be effectively protected when examination of ground indicates hazardous ground movement may be expected.
- 2) Sides of trenches in unstable or soft material, 5 feet or more in depth, shall be shored, sheeted, braced, sloped or otherwise supported by means of sufficient strength to protect the employees working within them. See Tables P-1, P-2 (following paragraph (1) of this section).
- 3) Sides of trenches in hard or compact soil, including embankments, shall be shored or otherwise supported when the trench is more than 5 feet in depth and 8 feet or more in length. In lieu of shoring, the sides of the trench above the 5 foot level may be sloped to preclude collapse, but shall not be steeper than a 1 foot rise to each 1/2 foot horizontal. When the outside diameter of a pipe is greater than 6 feet, a bench of 4 foot minimum shall be provided at the toe of the sloped portion.
- 4) Materials used for sheeting and sheet piling, bracing, shoring, and underpinning, shall be in good serviceable condition and timbers used shall be sound and free from large or loose knots, and shall be designed and installed so as to be effective to the bottom of the excavation.
- 5) Additional precautions by way of shoring and bracing shall be taken to prevent slides or cave-ins when excavations or trenches are made in locations adjacent to backfilled excavations, or where excavations are subjected to vibrations from railroad or highway traffic, the operation of machinery, or any other source.
- 6) Employees entering bell-bottom pier holes shall be protected by the installation of a removable-type casing of sufficient strength to resist shifting of the surrounding earth. Such temporary protection shall be provided for the full depth of that part of each pier hole which is above the bell. A lifeline, suitable for instant rescue and securely fastened to a shoulder harness, shall be worn by each employee entering the shafts. This lifeline shall be individually manned and separate from any line used to remove materials excavated from the bell footing.
  - a) Minimum requirements for trench timbering shall be in accordance with Table P-2.
  - b) Braces and diagonal shores in a wood shoring system shall not be subjected to compressive stress in excess of values given by the following formula:

$$S = 1300 - \frac{20L}{D}$$

$$\text{Maximum ratio } \frac{L}{D} = 50$$

Where:

L = Length, unsupported, in inches.

D = Least side of the timber in inches.

S = Allowable stress in pounds per square inch of cross-section.

- 7) When employees are required to be in trenches 4 feet deep or more, an adequate means of exit, such as a ladder or steps shall be provided and located so as to require no more than 25 feet of lateral travel.
- 8) Bracing or shoring of trenches shall be carried along with the excavation.
- 9) Cross braces or trench jacks shall be placed in true horizontal position, be spaced vertically, and be secured to prevent sliding, falling or kickouts.
- 10) Portable trench boxes or sliding trench shields may be used for the protection of personnel in lieu of a shoring system or sloping. Where such trench boxes or shields are used, they shall be designed, constructed, and maintained in a manner which will provide protection equal to or greater than the sheeting or shoring required for the trench.

- 11) Backfilling and removal of trench supports shall progress together from the bottom of the trench. Jacks or braces shall be released slowly and in unstable soil, ropes shall be used to pull out the jacks or braces from above after employees have cleared the trench.

TABLE P-1

<u>Soil Type</u>	Approximate Angle of Repose for <u>Slope of Sides of Excavations</u>
Solid Rock, Shales or Cemented Sand and Gravel	90 degrees
Compacted Angular Gravels	63 degrees 26' (1/2:1)
Recommended Slope for Average Soils	45 degrees (1:1)
Compacted Sharp Sand	33 degrees 41' (1-1/2:1)
Well Rounded Loose Sand	26 degrees 34' (2:1)

NOTE: Clays, silts, loams or non-homogenous soils require shoring and bracing. The presence of ground water required special treatment.

d. Definitions Applicable To This Subject:

- 1) "Accepted Engineering Requirements (or practices)" - Those requirements or practices which are compatible with standards required by a registered architect, a registered professional engineer, or other duly licensed or recognizable authority.
- 2) "Angle of Repose" - The greatest angle above the horizontal plane at which a material will lie without sliding.
- 3) "Bank" - A mass or soil rising above a digging level.
- 4) "Belled Excavation" - A part of a shaft or footing excavation usually near the bottom and bell-shaped; i.e., an enlargement of the cross section above.
- 5) "Braces (trench)" - The horizontal members of the shoring system whose ends bear against the upright or stringers.
- 6) "Excavation" - Any man-made cavity or depression in the earth's surface, including its sides, walls, or faces, formed by earth removal and producing unsupported earth conditions by reasons of the excavation. If installed forms or similar structures reduce the depth-to-width relationship, an excavation may become a trench.
- 7) "Faces" - See paragraph "k." of this section.
- 8) "Hard Compact Soil" - All earth materials not classified as running or unstable.
- 9) "Kick-outs" - Accidental release or failure of shore or brace.
- 10) "Sheet pile" - A pile, or sheeting, that may form one of a continuous interlocking line, or a row of timber, concrete or steel piles, driven in close contact to provide a tight wall to resist the lateral pressure of water, adjacent earth, or other materials.
- 11) "Sides", "Walls", or "Faces" - The vertical or inclined earth surfaces formed as a result of excavation work.
- 12) "Slope" - The angle with the horizontal at which a particular earth material will stand indefinitely without movement.
- 13) "Stringers" (wales) - The horizontal members of a shoring system whose sides bear against the uprights or earth.
- 14) "Trench" - A narrow excavation made below the surface of the ground. In general, the depth is greater than the width but the width of a trench is not greater than 15 feet. o.  
"Trench Jack" - Screw or hydraulic type jacks used as cross bracing in a trench shoring system.

- 15) "Trench Shield" - A shoring system composed of steel plates and bracing, welded or bolted together, which support the walls of a trench from the ground level to the trench bottom and which can be moved along as work progresses.
- 16) "Unstable Soil" - Earth material, other than running, that because of its nature or the influence of related conditions cannot be depended upon to remain in place without extra support, such as would be furnished by a system of shoring.
- 17) "Uprights" - The vertical members of a shoring system.
- 18) "Wales" - See paragraph "m." of this section.
- 19) "Walls" - See paragraph "k." of this section.

*Additional information may be obtained from the U.S. Department of Labor Occupational Safety and Health Administration (OSHA), 525 Griffin Square Building, Room 602, Dallas, Texas 75202, (214) 767-4731.*

B. Trench Box:

1. Contractor may purpose, as an alternate, the use of a sliding or moveable trench box instead of trench shoring.
2. Contractor shall submit details and full design data for the trench box to the Engineer for review and approval.

C. Government Agency Approval:

1. Contractor shall submit trench safety design to the appropriate government agencies for approval in accordance with current requirements.

END OF SECTION

**SECTION 313116**  
**TERMITE CONTROL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Work required for this Section includes soil treatment for termite control including supplementary Work necessary for its installation.

**1.2 DEFINITIONS**

- A. EPA: Environmental Protection Agency.
- B. PCO: Pest control operator.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Treatments and application instructions, including EPA-Registered Label.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.
- B. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:
  - 1. Date and time of application.
  - 2. Moisture content of soil before application.
  - 3. Brand name and manufacturer of termiticide.
  - 4. Quantity of undiluted termiticide used.
  - 5. Dilutions, methods, volumes, and rates of application used.
  - 6. Areas of application.
  - 7. Water source for application.
- C. Qualification Data:
  - 1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects.
- D. Warranties: Special warranties specified in this Section.

**1.5 QUALITY ASSURANCE**

- A. Applicator Qualifications: A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.
- B. Regulatory Requirements: Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

## **1.7 COORDINATION**

- A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

## **1.8 WARRANTY**

- A. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
- B. Warranty Period: Five years from date of Substantial Completion.

## **1.9 MAINTENANCE SERVICE**

- A. Continuing Service: Provide a proposal for continuing service, including monitoring, inspection, and retreatment for occurrences of termite activity, from applicator to Owner, in the form of a standard yearly (or other period) continuing service agreement, starting on the date of Substantial Completion. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## **PART 2 - PRODUCTS**

### **2.1 SOIL TREATMENT**

- A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earth moving, slab and foundation work, landscaping, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected. Starting of Work will be construed as installers acceptance of installation conditions.

### **3.2 PREPARATION**

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.
- C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

### **3.3 APPLYING SOIL TREATMENT**

- A. General: Apply soil treatment under all enclosed structures. Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.
- B. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.
- C. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
- D. Foundations: Adjacent soil including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footers, piers, and chimney bases; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
- E. Crawlspace: Soil under and adjacent to foundations as previously indicated.
- F. Adjacent Areas: Around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
- G. Penetrations: At expansion joints, control joints, and area where slabs will be penetrated.
- H. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- I. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- J. Post warning signs in areas of application.
- K. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION



## SECTION 32 11 23 - AGGREGATE BASE COURSE

### PART 1: GENERAL

#### SUMMARY

- A. Section Includes: Furnishing, Placing and Compacting crushed aggregate on a prepared surface for use as a base course.
- B. Related Sections: Contractor shall refer to the Oklahoma Department of Transportation Standard Specifications for Highway Construction, Latest Revisions. Materials and construction methods shall conform with ODOT Standard Specifications.

#### SUBMITTALS

- A. General: Submittals shall be according to General Conditions
- B. Test Data: Submit three copies of test data for the Contractor-furnished aggregate to be used on this project. Testing shall have been performed by an independent testing laboratory within 12 month of submitting the report for approval.
- C. Certificates of Conformance: Submit three copies of written certification from the supplier of the Contractor-furnished aggregate to be used on this project that it conforms to the requirements of this specification section.
- D. Samples: If requested, submit three samples of each gradation of aggregate to be used on this project.

#### QUALITY ASSURANCE

- A. Quality Assurance Plan: Submit a written Quality Assurance Plan for approval by the Owners Representative. The plan shall include but not be limited to testing procedures and frequency of tests to ensure that the requirements of these specifications are met.
- B. Stockpiles: Segregate differing aggregates.

#### DELIVERY, STORAGE AND HANDLING

- A. Delivery: Mitigate spillage or damage that occurs during delivery.

#### WARRANTY

- A. Requirements: Aggregate base found to be defective within 12 months after work completion, shall be replaced at the Contractor's expense. Overlaying material that must be replaced because of defective base material shall also be replaced at the Contractor's expense.

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. Contractor-Furnished Crushed Aggregate: Shall consist of hard, durable particles or fragments of crushed stone or crushed gravel. Shall be crushed to the size and quality requirements for crushed aggregate materials normally used locally in the construction and maintenance of highways.

1. The base aggregates shall have a maximum size of [1-1/4] inch. Plasticity index for base aggregates shall be less than 6. Base aggregates shall be uniformly graded from coarse to fine and shall be free of vegetable matter and clay balls.
- B. Aggregate for Untreated Subbase or Base: Shall consist of hard, durable particles or fragments of crushed stone, or crushed aggregate. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used.
1. Coarse aggregate is the material retained on the Number 10 sieve and shall have a percentage of wear of not more than 50 as determined by AASHTO Method T 96.
  2. Fine aggregate is the material passing the Number 10 sieve and shall consist of natural or crushed sand and fine mineral particles. The fraction passing the Number 200 sieve shall not be greater than two-thirds of the fraction passing the Number 40 sieve. For subbase and base courses, the fraction passing the Number 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 6. For surface courses, the fraction passing the number 40 sieve shall have a liquid limit not greater than 35 and a plasticity index not less than 4 or greater than 9.
  3. Material shall be free from organic matter and lumps or balls of clay.
  4. Not less than 50% by weight of the particles retained on the No. 4 sieve shall have at least one fractured face.
  5. Aggregate gradation shall conform to the requirements of Table 2-1 for the designation shown in the Bid Schedule or on plans. Gradation of each designated size of aggregates shall be obtained by crushing, screening, and blending processes as may be necessary.

TABLE 2-1					
Gradation Target Values for Aggregate Subbase, Base, or Surface Courses (Percentage by weight passing square mesh sieves, AASHTO T 27)					
Sieve Designation	Grading Designation (maximum size)				
	A	B	C	D	E
	subbase	(2 inch)	(1-1/2 inch)	(1 inch)	(3/4 inch)
2-inch		100			
1-1/2-inch	100	40-100	100		
1 inch				100	
3/4-inch	40-100	30-75	57-87		100
1/2-inch				59-89	
3/8-inch	30-75	25-60			
No. 4	25-60	20-50	28-58	35-65	41-71
No. 10	20-43	15-35	15-35		
No. 40	8-26	6-22	7-22	11-27	12-28
No. 200	4-12	0-12	3-10	4-16	5-17
*Tolerances shall not apply to 100% passing requirements.					

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Requirements: Slide material including culvert inlet and outlet debris, shall be removed and the existing roadbed, including parking areas shall be scarified, bladed, and shaped. The material shall be in conformity with the line, grade, and cross sections shown on the plans or established by the Owners Representative. High places in the road-bed shall be cut to grade and the resulting material hauled and deposited on low areas on fill slopes as approved by the Owners Representative. If depressions or narrow embankments remain, sufficient approved material shall be obtained. Place material to bring the width and surface of the roadway in close conformity with the lines, grades, and cross sections shown on the plans or established by the Owners Representative. The roadbed shall then be rebladed and reshaped. At intersections, the roadbeds of side roads shall be treated similarly, as governed by the grading performed, to provide for proper joining of the proposed and existing riding surfaces. The roadbed shall be compacted. A complete and acceptable foundation shall be constructed. The roadbed shall be in specified condition at the time of placement of the base course, surface course, or pavement. Tolerances for placement shall be as found in ODOT Section 301-General Requirements for Bases

### 3.2 MIXING

- A. General: Unless otherwise specified, mix the material by one of the following methods During the mixing, water shall be added in the amount necessary to provide the optimum moisture content for compaction.
- B. Stationary Plant Method: The materials shall be mixed in an approved mixer. Water shall be added during the mixing operation in the amount necessary to provide the moisture content for compacting to the specified density. After mixing, the material shall be transported to the job site while it contains the proper moisture content and shall be placed by means of an approved aggregate spreader.
- C. Travel Plant Method: After the material for each course has been placed through an aggregate spreader or windrow sizing device, the material shall be uniformly mixed by a traveling mixing plant. During the mixing, water shall be added in an amount sufficient to provide the necessary moisture content for compacting.
- D. Road Mix Method: After material for each course has been placed, the materials shall be mixed while at required moisture content by means of motor graders or other approved equipment until the mixture is uniform throughout.

### 3.3 INSTALLATION

- A. General: The material shall be placed on the prepared surface and compacted in layers of the thickness shown on the drawings. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.
  - 1. Placing shall be from vehicles equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted, the finished layer shall have the required thickness.
  - 2. When hauling is done over previously placed material, hauling equipment shall be routed uniformly as possible over the entire surface of the constructed layers.
- B. Spreading: When uniformly mixed, the mixture shall be spread smoothly for compaction to the required thickness.
- C. Compacting: Immediately following final spreading and smoothing, each layer shall be compacted to the full width by approved compaction equipment. Rolling shall progress

gradually from the sides to the center, parallel to the centerline of the road, or parking area, and shall continue until the surface has been rolled. Irregularities or depressions that develop shall be corrected by loosening the material at these places. Add or remove material until the surface is smooth and uniform. Along curbs, headers, and walls, and at places not accessible to the roller, the base material shall be compacted thoroughly with approved tampers or compactors.

- D. Compacting and Finishing Cement-Treated Base Material: After the cement-treated mixture has been spread, compact the mixture to a density of not less than 95 percent of the maximum density. The density shall be determined on a sample of cement aggregate mixture obtained from the area being processed at the time compaction begins, according to AASHTO T 134.
- E. Watering: Provide water and watering equipment to control dust and obtain required compaction.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: The Contractor shall make arrangements for a certified independent testing laboratory, according to the requirements of Section 01458 - Testing Laboratory Services, to perform the required testing, recording, and distributing of the results.
- B. Density:
  - 1. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density determined according to AASHTO T 180 Method D, or other method approved in writing by the Owners Representative, has been achieved.
  - 2. In-place field density determinations are made according to AASHTO T 191, AASHTO T 205, or other approved method. The use of AASHTO T 224 to correct for oversize particles may be required.
  - 3. Test holes are made at random during the work to determine the depth of uncompacted layers required to produce the designated depth of material after compacting to the specified density.
  - 4. Cutting of the test holes and refilling with materials properly compacted shall be done by the Contractor and approved in writing by the Owners Representative.
  - 5. Mixtures of aggregate, cement, and water that have not been compacted shall not be left undisturbed for more than 30 minutes.
  - 6. The percentage of moisture in the completed cement-treated base mixture shall be in a range from the optimum moisture content of the mixture to + 2 percentage points, as determined by AASHTO T 134.
  - 6. The compacting and finishing shall be completed within 2 hr of the time water is added to the cement-treated base mixture. The compacted surface shall be a proper cross section, smooth, dense, and free of compaction planes, ridges, and loose material.
- C. Completed Course Thickness: Shall not vary more than 1/2-inch from the thickness required.
- D. Surface: Will be tested for acceptance by the Contractor with a 10-ft straight edge after the base has been bladed and rolled into a smooth surface. Areas where the surface variation exceeds 1/2 inch in 10 ft shall be reworked until the variation falls within this limit.

### 3.5 PROTECTION

- A. Cement-Treated Base Materials: Shall be cured with a bituminous curing seal applied within 24 hours after the completion of initial rolling. The surface shall be kept moist until the seal is applied.
  - 1. The curing seal shall be applied at a rate between 0.10 and 0.25 gal/ yd<sup>2</sup> of surface. The curing seal shall be applied in sufficient quantity to provide a continuous film over the base surface. The film shall be maintained at least 7 days unless the treated base is protected by a subsequent course.
  - 2. Cement-treated base shall not be mixed or placed while the atmospheric temperature is below 35 degrees F or when conditions indicate that the temperature may fall below 35

degrees F within 24 hr of placement. Cement-treated base shall not be placed on frozen subgrade or mixed when the aggregate is frozen. Cement-treated base shall be protected from freezing for a period of 5 days after placing and whenever the atmospheric temperature falls below, or is expected to fall below 32 degrees F.

- B. Aggregate Base Course: Contractor may, with Owners Representatives approval, apply Prime Coat of Bituminous Material to seal the aggregate base, to maintain moisture, in instances where the surface course may not be applied immediately.

END OF SECTION

## SECTION 32 13 13 - CONCRETE PAVING

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Concrete or rigid paving. Work consists of furnishing materials for and construction of concrete paving. Paving to be of thickness and section shown on plans or as directed by Engineer.

#### 1.2 REFERENCES

- A. Oklahoma Department of Transportation Standard Specifications for Highway Construction, latest edition and revisions; Section 401-General Requirements for Surfaces; Section 414-Portland Cement Concrete Pavement; Section 701-Portland Cement Concrete.

#### 1.3 QUALITY ASSURANCE

- A. Failure Criteria: Not limited to the following:
1. Insufficient strength.
  2. Spalling, honeycomb.
  3. Insufficient thickness.

#### 1.4 PROJECT AND SITE CONDITIONS

- A. Site Conditions: Concrete paving shall not be placed on unapproved base course or subgrade. Contractor shall utilize hot weather or cold weather precautions as applicable to protect the integrity of the concrete.

### PART 2: PRODUCTS

#### 2.1 MATERIALS/CONSTRUCTION

- A. Concrete shall be as noted on plan sheets, or 3,500psi 28-day compressive strength as a minimum unless noted otherwise.

Cement:	ASTM C150, Type I or III unless otherwise noted;
Coarse Aggregate:	Crushed rock, washed gravel or other inert material conforming to ASTM C33;
Water:	Potable, clean and free from deleterious substances;
Reinforcing Steel:	ASTM A615, Grade 60; unless otherwise noted;
Welded Wire Fabric:	ASTM A185;
Forms:	(No wood rot or deteriorated wood shall be accepted) Plywood - Waterproof, resin-bonded, exterior type, face to concrete Grade B or better; Lumber - Straight, uniform width and thickness and free from knots, offsets, holes, dents and other surface defects; Chamfer Strips -3/4" clear white pine, surface against concrete planed;
Form Coating -	Industrial lubricants "Non-Crete" form coating, Protex "Pro-Cote" or equal;
Expansion Joints -	Preformed, bituminous type ASTM D994, unless otherwise noted;
Air Entraining Admixture:	ASTM C60,
Water Reducing Admixture:	ASTM C494 Type A
Fly Ash:	No more than 15% cement replacement

Moisture Retaining Cover: Polyethylene film, or polyethylene coated burlap meeting ASTM C171.

Liquid Membrane Curing Compound: Meeting AASHTO M148/ASTM C309 Type 2 or Type 1-D. White pigment or red dye.

- B. Finish surfaces to proper line and grade as shown on plans or directed by Engineer.
- C. Paving surface shall receive a "burlap drag" texture and grooved or tined to produce a skid resistant surface.
- D. After surface finishing and as soon as practical, cover and cure the entire surface with cotton or burlap mats; impervious membrane spray; or polyethylene sheeting.
- E. Contractor shall submit a placement & jointing layout plan to Engineer for approval. Joint panel shall be situated to avoid joints within a flowline or swale.
- F. Construction joints may be approved only at locations shown on the plans or approved by the Engineer.
- G. Contraction joints to be placed at a maximum of 15 feet each way, as noted on the plans, or as directed by the Engineer. Contraction joints may be sawcut or formed.
- H. Expansion joints shall be placed to isolate the pavement from structures or fixed objects, such as light foundations, drainage inlets and buildings.
- I. Surface tolerance shall be tested with a 10-foot straightedge. Maximum variation from the testing edge of the straightedge between any two contact points shall not exceed 1/8-inch. Contractor shall correct surface irregularities exceeding the aforementioned tolerance in an acceptable manner.
- J. Exclude traffic from the surface for a period of at least 14-days after the concrete is placed. Paving shall be protected from damage, staining, marring, etc.
- K. Pavement may be rejected because of unsound concrete, uncontrolled cracking, malfunctioning of the sawed joints, spalling, honeycomb, surface irregularities, or insufficient thickness.
- L. Grade changes within the pavement such as crowns, or valleys shall be rounded within five feet each side of the crown or valley to provide a smooth surface.

## SECTION 32 16 13-CONCRETE CURB AND GUTTER

### PART 1: GENERAL

#### 1.1.1 SUMMARY

- A. Section Includes: Construction of concrete curb and gutter, either together or independently
- B. Related Sections & References: Oklahoma Department of Transportation Standard Specifications for Highway Construction, Section 609-Integral Curb, Combined Curb and Gutter; Section 701-Portland Cement Concrete

#### 1.2 QUALITY ASSURANCE

- A. Failure Criteria: Not limited to the following:
  - 1. Concrete damaged during form removal
  - 2. Concrete chipped, broken, or defaced
  - 3. Concrete out of grade or alignment

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. Concrete: Shall have a 28-day strength of 3,500 psi and shall conform to the requirements of Section 03 30 53 – Cast in Place Concrete.

#### 2.2 SOURCE QUALITY CONTROL

- A. Inspection: Forms will be inspected and approved by the Owners Representative prior to concrete placement. The Owners Representative will receive two working day notice prior to concrete placement.
- B. Testing: The Contractor shall make arrangements for a certified independent testing laboratory, according to the requirements of Section 01 45 29 - Testing Laboratory Services, to perform the required testing, recording, and distributing of the results.

### PART 3: EXECUTION

#### 3.1 PREPARATION

- A. Earthwork: Excavation and embankment for curbs and gutters shall be as described in the applicable provisions of the project documents. Unsuitable material in the subgrade shall be removed to a specific depth and then backfilled with imported backfill. Payment will not be allowed for excavation below grade and for backfill materials required when such excavation is caused by negligence of the Contractor.
- B. Compaction: Subgrade shall be compacted to 95% maximum density according to AASHTO T 99, unless noted otherwise.
- C. Grading: Before forms are set, the subgrade shall be graded to within one inch of established grade, and the area between the sidewalk and the adjacent property shall be shaped to line, grade, and section shown on the drawings. Low areas in the subgrade shall be backfilled with imported backfill and compacted.
- D. Subgrade Moisture: Dry areas in the subgrade shall be thoroughly dampened prior to placing concrete.



### 3.2 FORMS

- A. General: Forms shall be of wood, metal, or other suitable material and shall extend for the full depth of the concrete. Forms shall be constructed to allow easy removal without prying or hammering against the fresh concrete. Concrete damaged during form removal will be rejected.
- B. Alignment: Set forms to the lines and grades shown on the drawings. Allowable tolerance for setting forms shall be as follows:
  - 1. Top shall not deviate more than 1/8-inch in 10 ft.
  - 2. Alignment shall be within 1/4-inch in 10 ft.
  - 3. On 300-ft radius curves or less, forms shall conform to the radius shown on the drawings.
- C. Bracing: Forms shall be braced to prevent deformation and displacement.
- D. Divider Plates: Shall be of metal.
- E. Preparation: Wooden forms may be oiled or watered immediately before placement of concrete. Water shall be clean. Water shall not be used when the atmospheric temperature is less than 40 degrees F. Steel forms shall be lightly oiled with a good grade of form oil prior to placing concrete. Excess oil shall be removed.

### 3.3 PLACING AND FINISHING CONCRETE

- A. Placement: Concrete shall be spread uniformly between the forms and thoroughly compacted with a vibrator or other acceptable method.
- B. Curb Machine: The curb or curb and gutter may be constructed by the use of a curb-forming machine provided it produces the required results. When the curb machine is used, contraction joints shall be created in a manner approved by the Owners Representative.
- C. Curb Template: When approved by the Owners Representative, the exposed curb face may be constructed and finished by use of trowel-type templates, shaped to produce the desired contours when operated along approved forms set to the established lines and grades. When the concrete is green, the top, front, or other exposed surfaces of the curb or combined curb and gutter shall be floated with a moist wood float. Form marks and other irregularities shall be removed.
- D. Floating: After compaction and leveling, the concrete shall be floated.
- E. Edging: Joints shall be edged with a 1/4-inch radius edge.
- F. Surface Finishing: The surface shall be brushed with a fiber hair brush in a transverse direction. For the purpose of matching adjacent concrete finishes or for other reasons, the Owners Representative may permit other methods of finishing. No plastering will be permitted.
- G. Contraction Joints: Curbing shall be constructed in sections having a uniform length of 15 ft. maximum unless noted otherwise. Prior to final set of the concrete, joints shall be tooled in the curb to a width of 1/8 inch, except at expansion joints. The sidewalk and curb contraction joints shall match where practicable.
- H. Expansion Joints: Shall be placed at intervals of 100ft maximum, using a preformed expansion joint filler extending the full width of the structure, and have a thickness of 3/4 inch. The sidewalk and curb expansion joints shall match. Expansion joint shall also be placed where the curb and gutter abut existing structures, existing paving, etc. Joints shall be sealed with an approved sealant.

### 3.4 BACKFILLING

- A. Requirements: After the concrete has cured for 14 days minimum, the spaces in front and back of the curb shall be backfilled to the required elevation with material similar to adjacent materials which shall be thoroughly tamped, in layers of not more than 6 inches. The concrete shall be cured for 28 days before paving materials are filled against it.

### 3.5 PRECAST CONCRETE CURB - NOT ALLOWED

### 3.6 FIELD QUALITY CONTROL

- A. Inspection: Forms will be inspected and approved by the Owners Representative prior to concrete placement. The Owners Representative will receive TWO working day notice prior to concrete placement.
- B. Testing: The Contractor shall make arrangements for a certified independent testing laboratory, according to the project documents, to perform the required testing, recording, and distributing of the results.
- C. Rejected Concrete Curb: Curbs that are chipped, broken, out of grade or alignment, will be rejected. Replacement curb shall match existing curbing.

### 3.07 CLEANING

- A. Clean-up: Concrete spilled or splashed on adjacent surfaces shall be thoroughly removed. After form removal, backfill and landscape to match surrounding area.
- B. Excess Materials: Excess and waste material shall be disposed of off the site.

END OF SECTION

## SECTION 32 16 14 - CONCRETE SIDEWALKS

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Construction of concrete sidewalks.

#### 1.2 SUBMITTALS

- A. Records: Submit copies of certified delivery tickets for all concrete used on this project.

#### 1.3 QUALITY ASSURANCE

- A. Failure Criteria: Not limited to the following:
  1. Concrete damaged during form removal.
  2. Concrete chipped, broken, or defaced.
  3. Concrete out of grade or alignment.

#### 1.4 SITE CONDITIONS

- A. Placing During Cold Weather: Discontinue concrete placement when the air temperature is below 40 degrees F (5 degrees C).
- B. Placing During Warm Weather: The temperature of the concrete as placed shall not exceed 85 degrees F (30 degrees C) except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F (35 degrees C).

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. Concrete: Shall have a 28-day strength of 3,500 psi minimum, unless noted otherwise on plans. Water/Cement Ratio  $\leq 0.55$ . The entrained-air range shall be 5 to 7 percent. The slump range shall be 3-inches (50 mm) plus or minus 1-inch (25 mm) conforming to ASTM C 143.
- B. Reinforcing Steel: When specifically called for on the plans, shall be,
  1. Reinforcement bars: ASTM A 615, ASTM A 616, or ASTM A 617.
  2. Wire mesh reinforcement: ASTM A 185.
- C. Joint Materials:
  1. Expansion joint filler strips shall be premolded, nonextruding type for use in concrete conforming to ASTM D 1751 or ASTM D 1752, (1/2 inch) thick or as noted on the plans.
  2. Joint sealant, self leveling low modulus silicone for use in sealing concrete pavement joints.
- D. Curing Materials: NOTE: If concrete is planned to receive a stain, colored, stamped, or other applied finish, Impervious sheet or membrane-forming curing compound,. Impervious sheet shall be white opaque polyethylene 4 mil thick, conforming to ASTM C 171; waterproof kraft paper; or polyethylene-coated burlap conforming to AASHTO M 182. Membrane-forming curing compound shall be AASHTO M148/ASTM C309 Type 2 or Type 1-D. White pigment or red dye.

- E. Concrete Protection Materials: Linseed oil mixture shall be equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used except that emulsified mixtures are not acceptable.
- F. Formwork: Form work shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of a height equal to the full depth of the finished sidewalk.
  - 1. Wood Forms: Shall be No. 2 common lumber or better against unexposed concrete surfaces. Wood forms against exposed concrete surfaces shall be dressed and matched boards of uniform thickness and widths not exceeding 10 inches. Plywood, conforming to the requirements for formwork as set forth in the American Plywood Association Concrete Forming Guide, may be used against both exposed and unexposed concrete surfaces. Plywood shall be at least 9/16-inch thick and have not less than 5 plies.
  - 2. Steel Forms: Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet (3 m) with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.
- G. Base Course Material: Shall be sand, limestone screenings or select materials.

## PART 3: EXECUTION

### 3.1 PREPARATION

- A. Earthwork: Excavation and embankment for sidewalks shall be as described in the applicable provisions of the specifications. Unsuitable material in the subgrade shall be removed to a specific depth and then backfilled with imported backfill.
- B. Compaction: Subgrade shall be compacted to a min. of 95 percent maximum density according to AASHTO T 99.
- C. Grading: Before forms are set, the subgrade shall be graded to within one inch of established grade and the area between the sidewalk and the adjacent property shall be shaped to line, grade, and section shown on the drawings. Low areas in the subgrade shall be backfilled with imported backfill and compacted.
- D. Subgrade Moisture: Dry areas in the subgrade shall be thoroughly moist when placing concrete. Subgrade shall be free from frost when the concrete is deposited.

### 3.2 FORMS

- A. General: Forms shall be of wood, metal, or other suitable material and shall extend for the full depth of the concrete. Forms shall be constructed to allow easy removal without prying or hammering against the fresh concrete.
- B. Preparation: Wooden forms may be oiled or watered immediately before placement of concrete. Water shall be clean. Water shall not be used when the atmospheric temperature is less than 40 degrees F. Steel forms shall be lightly oiled with a good grade of form oil prior to placing concrete. Excess oil shall be removed.

- C. Alignment: Set forms to the lines and grades shown on the drawings. Allowable tolerance for setting forms shall be as follows:
1. Top shall not deviate more than 1/8-inch in 10 feet (3 mm in 3 meter) section.
  2. Alignment shall be within 1/4-inch in 10 feet (1.5 mm in 3 meter ) section.
  3. Transverse slope [as indicated] of 1/4 inch per foot (6 mm per 300 mm ) with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.
- D. Bracing: Forms shall be braced to prevent deformation and displacement.

### 3.3 PLACING AND FINISHING CONCRETE

- A. Concrete Placement: Spread concrete in one layer uniformly between the forms and thoroughly compact with a vibrator and a steel-shod strikeboard.
- B. Floating: After compaction and leveling, the concrete shall be floated with wood floats and finished with a steel float except where designated for exposed-aggregate finish.
- C. Smooth Finish: After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.
1. For the purpose of matching adjacent concrete finishes or for other reasons, the Owners Representative may permit other methods of finishing. No plastering will be permitted.
- D. Exposed Aggregate Finish (If specifically required):
1. When concrete has reached initial set, wash retarded-concrete surfaces with water and scrub with stiff-bristle brush until aggregate is sufficiently and uniformly exposed and matches accepted panel samples.
  2. If adequate aggregate exposure cannot be obtained with the method specified above, scrub with acid-etch solution until aggregate is sufficiently and uniformly exposed and matches accepted sample panels.
  3. Do not over-expose aggregate.
  4. When desired finish is achieved, wash and rinse exposed-aggregate finish. If acid etch is used, neutralize before wash and rinse.
- E. Edge and Joint Finishing: Edge sides of walk with 1/2-inch radius edger. Edge transverse joints before brooming; eliminate the ridge and flat surface left by the edger. Ensure corners and edges are solidly filled before edging to prevent crumbling or low areas.
- F. Sidewalk Joints: Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width of 5 feet (1.5 m) on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along centerline of all sidewalks 10-feet (3 m) or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints, in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.
1. Contraction Joints: Transverse contraction joints, cut to a depth of at least 1/4 the thickness of the concrete, prior to final set of the concrete, shall be tooled in the sidewalks at a distance equal to the sidewalk width or 5 feet (1.5 m) on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet(3 m) or more in width] [or as shown on the drawings]. Where practical, the

sidewalk and curb contraction joints shall match. Contraction joints must be made within 2 hours of placement.

2. Expansion Joints: Place with top edge not less than 1/4-inch (6 mm) nor more than 1/2-inch (12 mm) below the surface and hold in place to prevent warping during floating and finishing. Place at structures, at driveways, and at points of tangency and curvature.
  - a. Expansion-joint material shall extend the full width of the structure.
  - b. Expansion-joint material shall extend to the subgrade.
  - c. Concrete over the joint filler shall be removed.
  - d. At the end of the curing period, remove filler strips, then carefully clean and fill expansion joints with joint sealer flush with the concrete surface in such manner as to minimize spilling on the walk surface. Concrete at the joint shall be surface dry and the atmospheric and pavement temperatures shall be above 50 degrees F (10 degrees C) at the time of application of joint-sealing materials. Immediately remove spilled sealing material and clean the surface of the walk.
    - (1) Joint Sealing compound shall be installed on all joints.

G. Reinforcement-Steel Placement:

1. Reinforcement steel, when specifically called for in the plans, shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

H. Construction Joints: Shall be formed around all appurtenances such as manholes, utility poles, extending into and through the sidewalk.

### 3.4 CURING

- A. General Requirements: Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.
- B. Mat Method: The entire exposed surface shall be covered with two or more layers of burlap. Mats shall overlap each other at least 6 inches (150 mm). The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.
- C. Impervious Sheeting Method: The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches (300 mm) when a continuous sheet is not used. The curing medium shall not be less than 18-inches (450 mm) wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.
- D. Membrane Curing Method: A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete

shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon (5 square meters per liter) for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

### 3.5 BACKFILLING

- A. Requirements: After the concrete has cured for 14 days, remove debris; then backfill, grade, and compact the spaces in front, back, and sides of the sidewalk to the required elevation with material similar to adjacent materials, in layers of not more than 6 inches (150 mm). The concrete shall be cured for 28 days before paving materials are filled against it.

### 3.5 FIELD QUALITY CONTROL

- A. Inspection: Forms will be inspected and approved by the Owners Representative prior to concrete placement. The Owners Representative will receive one working day notice prior to concrete placement.
- B. Testing: The Contractor shall make arrangements for a certified, independent testing laboratory, according to the requirements of Section 01 45 29 - Testing Laboratory Services, to perform the required testing, recording, and distributing of the results.

### 3.7 FIELD QUALITY CONTROL

- A. General Requirements: The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.
- B. Concrete Testing:
  - 1. Strength Testing: The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards (190 cubic meters) of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with

ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of two test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi (4 MPa).

2. Air Content: Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Owner inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3. Slump Test: Two slump tests shall be made on randomly selected batches of each class of concrete for every 190 cubic meters, (250 cubic yards,) or fraction thereof, of concrete placed during each shift. Slump shall not be more than [4 inches (100 mm)] for smooth finish walks; and not more than [3 inches (75 mm)] for exposed aggregate walks, as determined by ASTM C 143. Additional tests will be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noticed along the edges of slip-formed concrete.

C. Thickness Evaluation: The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

D. Surface Evaluation: The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

### 3.8 ADJUSTING

A. Surface Deficiencies and Corrections: Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which exceed plan grade, surface smoothness, or thickness tolerances shall be corrected as directed by the Owners Representative.

B. Thickness Deficiency: When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch (6 mm) the deficient section will be removed, between regularly scheduled joints, and replaced.

C. High Areas: In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch (6 mm). All pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

### 3.9 CLEANING



- A. Clean-up: Concrete spilled or splashed on adjacent surfaces shall be thoroughly removed. After form removal, backfill and landscape to match surrounding area.
- B. Excess Materials: Excess and waste materials shall be disposed of off the site.

### 3.10 PROTECTION

- A. General: Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.
- B. Protective Coating: Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.
  - 1. Application: Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and thoroughly clean before each application. Coverage shall be not more than 50 square yards per gallon (11 square meters per liter) for first application and not more than 70 square yards per gallon (15.5 square meters per liter) for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.
  - 2. Precautions: Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F. (10 degrees C.)

END OF SECTION

**SECTION 323223  
SEGMENTAL RETAINING WALLS**

**PART 1: GENERAL**

**1.1.1 SUMMARY**

- A. Section Includes: furnishing and installing blocks, soil reinforcement, and drainage systems for segmental retaining walls (SRWs).
- B. Related Sections:

**1.2 SUBMITTALS**

- A. Manufacturer's Literature: Block and manufacture shall match existing MSE wall on site. If specifically requested, submit five copies of the manufacturer's descriptive data appropriately marked to indicate proposed items to be used on this project. Include test data indicating compliance with specifications, and storage, handling, and installation instructions.

Submit information for the following materials.

- 1. Modular blocks: For each type of block to be used, submit block size and shape.
  - 2. Soil reinforcement.
  - 3. Filter fabric.
  - 4. Drainage Pipe
  - 5. Aggregate(s)
- B. Samples: For each type of block to be used, submit samples for approval of color, finish, and pattern of unit. Include 2 or more samples in each set showing the full range of variations expected.
  - C. Design Computations: Submit for approval structural wall design & analysis data signed and sealed by a Registered Professional Engineer.
    - 1. Include the effects of sloped backfill as indicated on the Drawings. Include global stability.
    - 2. Include the effects of superimposed loads as indicated on the Drawings.
    - 3. Design retaining walls according to AASHTO 2010 LRFD design recommendations.
    - 4. Include recommendations and information provided in project geotechnical recommendations.
  - D. Shop Drawings: Submit for approval project specific shop drawings showing the placement of blocks, soil reinforcing, backfill and drainage materials and filter fabric.

**1.3 QUALITY ASSURANCE**

- A. Mockups: If specifically requested, before installing segmental retaining walls, construct sample wall panels to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for completed work.
  - 1. Build mockups for each type of segmental retaining wall in sizes approximately 72 inches (1800 mm) long by 36 inches (900 mm) high above finished grade at front of wall.
    - a. Include typical base and cap or finished top construction.
    - b. Include backfill to typical finished grades at both sides of wall.
    - c. Include typical and construction at one end of mockup.
    - d. Include 36 inch (900 mm) return at one end of mockup with typical corner construction.
  - 2. Notify Owner's Representative 7 days in advance of the dates and times when mockups will be constructed.

3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
  - a. Approval of mockups does not constitute approval of deviation from Contract Documents contained in mockups, unless such deviations are specifically approved by the Owner's Representative in writing.
  - b. When directed, demolish and remove mockups from project site.
  - c. Approved mockups, in an undisturbed condition at the time of Substantial Completion may become part of the completed work.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in undamaged condition.
- B. Store and handle retaining wall units and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, or other causes.
- C. Store accessories, including metal items, in a manner to prevent corrosion and accumulation of dirt and oil.
- D. Store and handle geotextiles according to ASTM D 4873.

### PART 2: PRODUCTS

#### 2.1 RETAINING WALL UNITS AND ACCESSORIES

- A. Concrete Units: Regular-weight concrete units, designed for use in segmental retaining walls, complying with ASTM C 1372, with net-area compressive strength of 3000 psi for average of 3 units and 2500 psi for individual unit, maximum water absorption of 8 percent, and variation in height limited to 1/16 inch.
- B. Provide units with lugs, projections, holes and pins, or hollow cores for filling with drainage fill to interlock with units above and below.
- C. Colors: Color of SRW units shall be identical to existing, believed to be Allan Block, style AB Classic-3 course pattern. Contractor to confirm prior to ordering materials.
- D. Surface Texture: Match existing.
- E. Shapes: Provide units of basic shapes and dimensions indicated.
- F. Batter: Provide units that offset from the course below to provide approximately 1/2 inch per foot batter.
- G. Special Units: Provide cap units and other special shapes as necessary to produce retaining walls of dimensions and profiles indicated and to provide indicated textures on exposed surfaces.
- H. For any corners shown on the construction plans, SRW units shall be capable of providing overlap of units on each successive course so that walls meeting at corner are interlocked and continuous. SRW units that require corners to be mitered shall not be allowed.
- I. Installation Materials:
  1. Pins: product supplied by retaining wall unit manufacturer for use with units provided, made from nondegrading polymer reinforced with glass fibers.
  2. Cap Adhesive: Product supplied or recommended by retaining wall unit manufacturer for adhering cap units to units below.

2.2 BASE

- A. Material for leveling pad shall consist of angular, crushed stone aggregate, compacted to a minimum of 95% Standard Proctor , and shall be a minimum of 8 inches (150 mm) in depth.

2.3 DRAINAGE FILL

- A. Washed gravel or washed crushed stone complying with ASTM D 448, gradation per drawings or as approved.

2.4 REINFORCED SOIL

- A. Unless noted otherwise on the plans, the reinforced soil material shall be free of debris. The reinforced material shall consist of the inorganic USCS soil types, GP, GW, SW, SP, or SM meeting the following gradation, as determined in accordance with ASTM D2487 and the USCS classification system:

<u>Sieve Size</u>	<u>Percent Passing</u>
2 inch (50 mm)	100
3/4 inch (19 mm)	75-100
No. 40 (425 mm)	0-60
No. 200 (75 mm)	0-15

Plasticity Index (PI) less than 15 and Liquid Limit (LL) less than 40 per ASTM D4318.

2.5 FILTER FABRIC

- A. Nonwoven pervious geotextile manufactured from polyester, nylon, or polypropylene fibers, with the following minimum average properties:
  1. Apparent Opening Size: No. 100 (0.15 mm) per ASTM D4751
  2. Permeability: 150 gpm/sq.ft. (100 lbf (445 N) per ASTM D 4632.
  3. Grab Tensile Strength: 100 lbf (445 N) per ASTM D 4632.

2.6 SOIL REINFORCEMENT

- A. A geotextile specifically manufactured for use as soil reinforcement, made from polyolefine, polyesters, or polyamides, and with the following properties(properties shown are for Mirafi Miragrid 3XT & 5XT:
  1. Tensile Strength: 3500 lb/ft (38 kN/m) / (4700 lb/ft (68.6 kN/m)) per ASTM D 6637 .
  2. Tensile Strength (at 5% strain) : 1056 lb/ft (15.4 kN/m) / 1740 lb/ft (25.4 kN/m) per ASTM D6637
  3. Long Term Allowable Design Strength: 1918 lb/ft (28.0 kN/m) / 2575 lb/ft (37.6 kN/m) per GRI GG-4b

Soil reinforcement geogrid shall be Mirafi Miragrid 3XT, or 5XT as noted on the plans, or an approved equal.

2.7 DRAINAGE PIPE

- A. The drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D 3034 or corrugated HDPE pipe manufactured in accordance with ASTM D 1248. All drainage outlets shall daylight above grade and be equipped with a mesh rodent screen.

## PART 3: EXECUTION

### 3.1 PREPARATION

- A. Examine areas to receive segmental retaining walls with Owner's Representative present for compliance with requirements for excavation tolerances, condition of leveling base, and other conditions affecting performance of retaining walls. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 MODULAR UNIT INSTALLATION

- A. General:
  - 1. Place units according to manufacturer's written instructions.
  - 2. Lay units in running bond, overlapping half units of course below.
  - 3. Form corners and ends as indicated in manufacturer's written instructions.
- B. Leveling Base: Excavate, level, moisture condition and compact base subgrade to not less than 95 percent of maximum dry density according to ASTM D 698(AASHTO T99). Leveling base shall be prepared to ensure full contact to the base surface of the concrete units.
- C. First Course:
  - 1. Place first course of retaining wall units on leveling base for full length of wall.
  - 2. Alignment and level shall be checked in all directions. Insure that all units are in full contact with the base, are properly seated, and are in firm contact with each other.
  - 3. Place and compact fill to top of first course. Place fill on both sides of wall at same time without disturbing alignment of units. Fill voids between and within units with drainage fill.
- D. Subsequent Courses:
  - 1. Sweep excess fill from tops of course below.
  - 2. Place units in firm contact, properly aligned, and directly on course below.
  - 3. Install shear/connecting devices per manufacturer's recommendations.
  - 4. Place and compact fill as each course is laid. Place fills on both sides of wall at same time, where both sides are indicated to be filled.
  - 5. Fill voids between and within units with drainage fill.
- E. Cap Units: Place cap units and secure with cap adhesive according to manufacturer's written instructions.

### 3.3 SOIL REINFORCEMENT INSTALLATION

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment, in accordance with manufacturer's installation instructions.
- B. Geogrid reinforcement shall be placed at the lengths and elevations shown on the drawings.
- C. Use additional geogrid at curved walls as needed to comply with manufacturer's written instructions.
- D. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units according to the manufacturer's written instructions. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut and anchored prior to backfill placement on the geogrid. Anchor geogrid with anchors recommended by geogrid manufacturer, in accordance with manufacturer's installation instructions.
- E. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100 percent coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

### 3.4 FILL PLACEMENT

- A. General: Comply with requirements of earthworks or embankment specifications and retaining wall unit manufacturer's written instructions.
- B. Place, spread, and compact fill in uniform lifts for full width and length of embankment as wall is laid and in such a manner that minimizes the development of slack in the geogrid and installation damage.
- C. Use only hand-operated compaction equipment within 5 feet of wall.
- D. Compact drainage fill to not less than 95 percent maximum dry density according to ASTM D 698.
- E. Compact reinforced soil fill to not less than 95 percent maximum dry density according to ASTM D 698.
- F. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid.
- G. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 5 MPH. Sudden braking and sharp turning shall be avoided.
- H. Place filter fabric against back of wall and place a layer of drainage fill at least 12 inches deep behind the filter fabric to within 12 inches of finished grade. Place another layer of filter fabric between drainage fill and reinforced soil fill.
- I. Wrap drainage pipe with filter fabric and place in drainage fill as indicated, sloped 1/4 inch per foot (1:50) to drain.

### 3.5 CONSTRUCTION TOLERANCES

- A. Wall Batter: when specified, do not vary from indicated slope by more than 2 degrees.
- B. Variation from Level: For bed-joint lines along walls, do not exceed 1/4 inch in 10 feet or 1 inch in 40 feet.
- C. Variation in Plan Position: For ends and faces of walls in relation to property lines, buildings, and other objects, do not vary from plan dimensions by more than 1 1/2 inches or from depicted plan relationship (scaled dimensions) by more than 3 inches.
- D. Variation in Linear Wall Line: For walls indicated as straight, do not exceed 1 1/2 inches in 10 feet.
- E. At face of wall, maximum horizontal gap between erected units shall be 1/8 inch.

### 3.6 FIELD QUALITY CONTROL

- A. Comply with Section 01 45 29 - Testing Laboratory Services for in-place soil density testing. Provide one test for every 2 feet (vertical) of fill placed and compacted, for every 50 lineal feet of retaining wall. Vary compaction test locations to cover entire area of reinforced soil zone.

### 3.7 ADJUSTING AND CLEANING

- A. Remove and replace segmental retaining walls of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if methods and results are approved by Owner's Representative.
  - 2. Segmental retaining walls not matching approved samples.
  - 3. Segmental retaining walls not complying with other requirements indicated.

- B. Replace in a manner that results in segmental retaining wall's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

## SECTION 33 05 16 - MANHOLES, VAULTS AND CLEANOUTS

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. SECTION INCLUDES: Excavation and furnishing of materials and labor to construct, finish and backfill new standard and drop manholes, vaults, pits and cleanouts.
- B. RELATED SECTIONS. Section 03 30 53 – Cast-in-Place Concrete.
- C. QUALITY CONTROL: Engineer shall have the right to reject structures based upon visual defects including out of roundness, rough interior, discoloration, warping or other defects which could affect the life and function of the structure.

#### 1.2 SUBMITTALS

- A. General: Submittals shall be according with the following.
- B. Manufacturer's Literature and material certification: Submit six copies of the manufacturer's descriptive data and shop drawings for product.

### PART 2: PRODUCTS

#### 2.1 MATERIALS:

- A. PRECAST MANHOLES: Precast manholes shall conform to the specifications for Precast Reinforced Concrete Manhole Sections, ASTM C478.
- B. CAST-IN-PLACE CONCRETE MANHOLES, VAULTS AND MANHOLE BASES: Concrete and related materials for cast-in-place concrete manholes, vaults and manhole bases shall conform, as a minimum, to the requirements of Section 03 21 00, and 03 30 53, of the specifications.
- C. STEPS: Not Required.
- D. CASTINGS:
  - 1. General. Castings for manholes, cleanouts, vaults, pits and other appurtenances shall conform to and be tested in accordance with the specifications for Gray Cast Iron, ANSI/ASTM A48, Class 30. Design shall be according to the standard details. All manhole frames and covers shall have all bearing surfaces machined so that fitting parts will not rattle or rock.
  - 2. Standard Covers. Where standard manhole frames and lids are specified on the plans, they shall be East Jordan Iron Works 2023 frame and cover, reversible manhole ring with 300-24 lid. Cover shall have the words "SANITARY SEWER" cast in the cover. Lamphole frame and lids, where specified shall be Deeter Casting Number 1828, by Deeter Foundry, Inc. or equal. Lids shall be designed for H-20 traffic loading. Reinforcing ribs shall be tapered to allow the lids to slide easily into the frame.
  - 3. Sealed Manhole Covers. Where sealed manhole lids are called for on the drawings, they shall be Neenah R-1915-F2, or equal. Gaskets shall be of the O-ring type placed in a machined recess in the frame. All bolts shall be stainless steel. The cover shall have the words "SANITARY SEWER" cast in the cover.
- E. PIPE SEALS. Pipe seals shall be Z-LOK or A-LOK as manufactured by A-LOK Products, Inc. Kornseal as manufactured by NPC, Inc. or equal.



F. MASTIC:

1. Bitumastic Joint Sealer. The bitumastic joint sealer shall meet or exceed all requirements of Federal Specification SS-S210A and AASHTO M-198, and shall consist of butyl rubber with 90% solids. Elastomeric polyurethane resin-saturated oakum, with 1-inch by 1-inch cross-section may be substituted for the bitumastic elastic material.

2. Trowelable Bitumastic. Trowelable bitumastic shall be a butyl rubber with minimum solids content of 83% by weight. Shrinkage shall be 20% maximum when tested in accordance with ASTM D2453.

G. BENTONITE WATERSTOP: Bentonite impregnated bituminous waterstop shall be used where shown on the Plans. Material shall be "WATERSTOP Rx" as manufactured by American Colloid Co., or equal.

H. WATER PROOF COATING: Water proof coating for the exterior of all precast and cast-in-place manholes shall be Kop-Coat Bitumastic 300-M or equal.

PART 3: EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Excavation for manholes, vaults, etc. shall be made with the minimum permitted dimensions which allow construction of the manhole in accordance with the Standard Details. Manholes are to be built to an elevation not less than that of the existing ground surface, or as shown on the Drawings.

2. New manholes shall be constructed with the pipe seals firmly embedded in the manhole walls at the proper elevation and orientation. Pipe seals shall be provided for all connections of new lines. Pipe shall be slipped into seals, and when applicable, positioned and firmly clamped. The annular space between the pipe and manhole wall shall be filled with compressible material on the exterior of the manhole. Bedding material shall be carefully placed and compacted around the pipe.

3. New manholes to be constructed over existing lines shall be of the cast-in-place or precast construction. Precast manhole sections shall have preformed blockouts positioned over the existing lines. Contractor shall expose and confirm the vertical and horizontal location of all existing lines associated with the manholes before their manufacture. The joints between the bottom of the base manhole section and the cast-in-place base shall be sealed with two continuous rows of the bitumastic joint sealer. The surfaces of the manhole section and base shall be smooth and flat to result in compression of the mastic. Surfaces shall be clean and dry.

The top of the base slab inside the manhole wall shall be left in a roughened condition to provide a bond for the bench and trough. Pipes shall penetrate until the top of the pipe is flush with the inside manhole wall. The blockout surface and outside of the pipe shall receive one strip of bentonite waterstop before the entire annular space is filled with concrete. The bench and trough shall be constructed of concrete.

4. The bench and trough in precast manholes with precast bases shall be constructed of grout to the lines and grades shown on the plans.

5. Above the base, the manhole bench and trough shall be carefully constructed of solid concrete or grout to maintain proper velocities. Changes in pipe grade, alignment or size shall be made by transition sections of the invert, determined by the lower half of the inlet and outlet pipes. All inverts shall be plastered, troweled and brushed to a smooth, clean surface. Inlet and

oulet pipes shall not project beyond the interior wall of the manhole. Upon completion of the manhole, all waste mortar and debris shall be removed from the invert.

6. Manholes connecting pipes less than 15 in. nominal diameter shall have an internal diameter of 4 ft. unless noted otherwise.

**B. MANHOLE BASES:**

1. Precast manholes shall have an integrally cast base conforming to ASTM C478 unless noted otherwise.
2. The base of the cast-in-place manholes and precast manholes without precast bottoms shall be constructed of 3000 psi minimum compressive strength concrete; 4" maximum slump.
3. All bases shall be constructed or set on a minimum 8 inches of crushed rock meeting the requirements of ASTM C-33 Gradation No. 1, thoroughly compacted to provide solid foundation.

**C. PRECAST CONCRETE MANHOLES:**

1. Minimum thickness shall be as shown on the Drawings.
2. All bases shall be constructed or set on a minimum 8 inches of crushed rock meeting the requirements of ASTM C-33 Gradation No. 1, thoroughly compacted to provide solid foundation.
3. Joints between precast reinforced concrete sections shall be sealed using bitumastic joint sealer. Two rows of mastic shall be used in each joint.
4. Adjustment rings under the manhole frame shall be used for adjustment to grade. No more than 8 inches of precast concentric rings may be used to bring the manhole to finished grade. All joints shall be sealed with two rows of bitumastic joint sealer. Bricks shall not be used for grade adjustments.

**D. CAST-IN-PLACE MANHOLES:**

1. Total water content of the concrete shall not exceed 5.4 gallons of water per 100 lbs of cement in the mix.
2. All bases shall be constructed or set on a minimum 8 inches of crushed rock meeting the requirements of ASTM C-33 Gradation No. 1, thoroughly compacted to provide solid foundation.
3. The base shall have a minimum diameter of 8 inches greater than the outside diameter of the manhole. The base shall have a minimum 10 inch thickness beneath the manhole wall and shall have reinforcing as shown on the drawings.

**E. WATER PROOF COATING:**

1. When noted on the drawings, the exterior surfaces of cast-in-place and precast manholes shall be waterproofed with two coats of Kop-Coat, Bitumastic 300-M or equal with a total dry film thickness of 16 mils or greater.
2. Coating may be shop or field applied on precast manhole sections.
3. Backfilling of the structure shall not be performed until the coating has fully cured.

3.2 LAMPHOLES: Cleanouts (lampholes) shall be located and constructed as shown on the Drawings. When the concrete cleanout frame base is completed, a standard cleanout frame is to be set in place and closed with a cleanout cover.

3.3 INTERIOR COATING: Where interior coating is required the work shall be performed in accordance with manufacturers recommendations and shall result in a uniform coating of 80 mils minimum dry film thickness on concrete, and 100 mils on brick, free of holes and other imperfections.

3.4 MANHOLE TESTING:

1. All new manholes shall be vacuum tested in accordance with ASTM C-1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill . If special conditions exist which would preclude the performance of a vacuum test, an exfiltration test may be performed with approval from the Engineer.
2. Manholes failing testing shall be repaired or replaced by the Contractor at no additional cost to the Owner and retested.
3. Observed inflow or infiltration entering the manhole shall constitute a failure and shall be repaired by the Contractor.
4. Vacuum Testing: Vacuum testing shall be performed as follows:
  - A. The testing shall be done after assembly of the manhole and all connections, prior to backfilling. Any visible leakage in the manhole or structure before during or after the test shall be repaired.
  - B. Contractor shall plug the pipe openings, and securely brace the plugs and pipe.
  - C. With the vacuum tester in place, the contractor shall inflate the compression band to 40 psi to effect a seal between the vacuum base and the structure; connect the vacuum pump to the outlet port with the valve open; and draw a vacuum to 10" Hg (-5psi) and close the valve.
  - D. The time shall be measured for the vacuum to drop to 9 inches Hg (-4.5 psi). Manholes will be considered to have failed if the time to drop 1 inch Hg is less than what is shown in the following table:

	MANHOLE DIAMETER (INCHES)				
Depth (feet)	48 inches	60 inches	72 inches	96 inches	144 inches
4	10	13	16	19	21
8	20	26	32	38	44
12	30	39	48	57	65
16	40	52	64	76	86
20	50	65	80	95	110
24	60	78	96	114	132
Each 2' addl.	+ 5 Sec.	+ 6.5 Sec	+8 Sec	+ 9.5 Sec	+ 11 Sec

3.5 EXFILTRATION TESTING:

1. All incoming and outgoing sewer and service lines shall be plugged by means of mechanical pneumatic plugs.
2. The manhole shall be filled with water in its entirety. Presoaking periods shall not be allowed.

3. Manholes shall be completely filled with water and a 20-minute period commenced immediately. The maximum allowable water drop from the rim to the free water surface within a 20-minute period shall be as follows:

MANHOLE DIAMETER	WATER DROP PER FOOT OF MANHOLE DEPTH
3	0.625
3.5	0.500
4	0.375
5	0.250

END OF SECTION

## SECTION 33 05 26 - UTILITY LINE MARKING

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Furnishing and installing utility marking and warning tape capable of being detected electronically and marker posts. Also install 12 Ga. High strength Copper clad tracer wire over all non-metallic pipe or conduit. Install test stations as required.

#### 1.2 SUBMITTALS

- A. General: Submittals shall be according with the following.
- B. Certificates of Conformance: Submit 6 copies of written certification from the supplier of the Contractor-furnished wood marker posts that the preservative treatment conforms to the requirements of this section. Submit copies of written certification from the supplier of the Contractor-furnished marker tape that the materials used in the tape fabrication meet the requirements of this section.

#### 1.3 DELIVERY, STORAGE, AND HANDLING

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. General: Tapes shall be manufactured specifically for warning and identification of buried utility lines. Metalized tape shall be used to locate non-metallic lines. Tapes shall be inert plastic specially formulated for prolonged use underground and shall be resistant to alkalies, acids and other destructive agents found in the soil. Tape shall be provided in rolls, 3-inch minimum width, color coded for intended service with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED [GAS PIPELINE] [COMMUNICATION CABLE - TELEPHONE] [ELECTRIC CABLE] [SEWER PIPELINE] [WATER PIPELINE] BELOW" or similar wording. Color code and letter coding shall be permanent, unaffected by moisture and other substances contained in trench backfill material.
- B. Color Codes: Shall be as follows:
  - 1. Electric Cable: Red
  - 2. Water Pipeline: Blue
  - 3. Gas Pipeline: Yellow
  - 4. Sewer Pipeline: Green
  - 5. Communication Cable: Orange
- C. Buried Warning and Identification Tape for Use in Trenches Containing Electrical Cable: Shall be 4-mil polyethylene plastic tape conforming to ASTM D 882.
- D. Buried Warning, Identification and Locator Tape for Use in Trenches Containing Non-Metallic Water and Sewer Lines: ASTM D 2103. It shall be 5.5-mil composition film containing one layer of metalized foil laminated between two layers of inert plastic film. Tape shall be detectable by cable locating equipment used to locate underground utility lines.
- E. Drivable, Flexible, Composite Utility Marker: Shall be durable, reinforced composite posts manufactured specifically for warning and identification of buried utility lines. Posts shall be 3-1/2 inches minimum diameter and a minimum of 72 inches in length, color coded for intended service with a 3-inch wide warning and identification decal attached. Post shall include two stainless steel terminal connections and 1-inch diameter screened vent to prevent moisture

buildup inside post. Marker shall be Carson Visi-Post Utility Test Station or equal. Warning and identification shall be "CAUTION BURIED (WATER, SEWER, etc.) PIPELINE BELOW" or similar wording. Code and letter coloring shall be permanent. Marker shall be Carson Visi-Post Utility Test Station or equal.

- F. Tracer Wire: Tracer wire shall be a #12 AWG fully annealed high strength copper clad steel conductor (HS-CCS), insulated with a 30 mil, high density, high molecular weight HDPE insulation. For instances where Directional Drilling/Boring is required, a higher strength tracer wire is required to be installed such as Copperhead SoloShot Extra High Strength(EHS) reinforced tracer wire or approved equal. Splices of tracer wire are to utilize Copperhead DryConn Direct Bury Twist-on connector with strain relief or approved equal.
- G. Flush to Ground Mounted Test Station: Shall be a durable reinforced composite device manufactured for use as a device in to aid in the location of underground utilities. Device shall be resistant to chemicals and corrosion. Device shall contain a steel insert molded into the bell for reinforcement and to insure that device is locatable via metallic location device. Device shall have a terminal board for connection of tracer or test wire. Test Station shall be at least 18 inches in length and at least 5 inches in diameter. Test station cap color shall correspond to the respective utilities standard APWA color designation("Water = Blue, Sewer= Green, Electric= red" etc.). Test Station shall be Part Number SP-LID- \*2 by Copperhead wire or approved equal. These devices are intended to be used in "developed" and regularly maintained areas where utility marker posts would not be aesthetically pleasing.

### PART 3: EXECUTION

#### 3.1 INSTALLATION

- A. Buried Warning and Identification Tape: Install tape continuously in backfill directly over buried utility line, 6 to 10 inches below finished grade. Install tracer wire approx. 12 inches over top of pipe or conduit.
- B. Drivable, Flexible, Composite Utility Marker & Test Station
  1. Location: Install flexible, composite utility marker in unpaved and unsodded areas at changes in horizontal direction or intervals not to exceed 1000 feet of sight distance.
  2. Installation: Install in a true, vertical plane directly over or immediately adjacent to the utilities to which they relate. Posts shall be driven to provide an anchoring depth of 18 to 24 inches.
- C. Flush to Ground Mounted Test Station
  1. Location: Install test stations in unpaved areas along the utility where practical, install at fire hydrants, at mainline valves, or at least every 1,000 ft.
  2. Install in a true, vertical plane directly over or immediately adjacent to the utilities to which they relate.

END OF SECTION

## SECTION 33 05 27 - CONNECTION TO EXISTING UTILITIES

### 1.0 GENERAL

#### 1.1 SCOPE

The work under this item shall include all excavation, furnishing all materials required, construction, finishing and backfilling of connections to existing mains, valves, manholes, additional drop connections to new drop manholes, special connections, services line reconnections, or plugs as indicated on the construction Plans or as directed by the Owner's representative.

### 2.0 PRODUCTS

#### 2.1 MATERIALS

Materials used in the performance of the work specified herein shall be as specified in other sections of these Specifications.

### 3.0 EXECUTION

#### 3.1 PLANS

The construction Plans show details of the various connections and they shall be made in accordance with the details unless directed otherwise by the Engineer.

#### 3.2 MANHOLES AND OTHER SIMILAR STRUCTURES

3.2.1 Connections to existing manholes and other similar structures shall be made by cutting into the structure at the specified grade, inserting the pipe, and encasing the joint with concrete. Bentonite impregnated mastic or an approved equal shall be applied to the pipe and manhole wall as shown on the Plans. Contractor shall not break into any existing sewer unless the Owner's Representative is present. Inlet and outlet pipes at the invert shall not project beyond the interior walls of the structure. The structure base and invert shall be cut and reconstructed in such a manner that a proper invert section is maintained. All waste mortar, debris and sharp edges shall be removed from the joints, bottom and invert. Contractor shall remove and replace the structure's steps in the proper location and in accordance with Standard Details if they are not properly located after the connection is made. Any and all diversion or temporary bypass pumping of water or sewage in a wet connection is included in this item.

3.2.2 Plugs shall be constructed of manhole brick and mortar or low-strength concrete, extending at least 1-foot into the line plugged from the structure. The plug shall be watertight and troweled to a smooth finish on the interior of the structure.

END OF SECTION

SECTION 33 05 33 - PLASTIC PIPE

PART 1: GENERAL

1.1 SUMMARY

- A. SECTION INCLUDES: Furnishing and installing Polyvinyl Chloride (PVC) pipe in the trench as specified to the line and grades given. The method of bedding shall be as shown on detailed drawings.
- B. RELATED SECTIONS. Testing, disinfection and other general requirements.
- C. QUALITY CONTROL: Engineer shall have the right to reject pipe based upon visual defects including out of roundness, rough interior, discoloration, warping or other defects which could affect the life and function of the pipe.

1.2 SUBMITTALS

- A. General: Submittals shall be according with the following.
- B. Manufacturer's Literature and material certification: Submit six copies of the manufacturer's descriptive data for pipe size, class and designation required for the project.

PART 2: PRODUCTS

2.1 PVC PRESSURE PIPE AND FITTINGS:

A. AWWA C900 TYPE:

- 1. Where called for in the bid schedule or where required for on plans, PVC shall meet the requirements of AWWA Designation C900. Pipe shall be cast iron outside diameter. Dimension Ratio of the pipe shall be as follows:

Pressure Class	Dimension Ratio
100	25
150	18
200	14

- 2. Pipe and fitting joints of size 2 inches in diameter and larger shall be slip joint, O-ring type joints.
- 3. Fittings for slip joint pipe 2 inches and larger shall be Cast Iron conforming to AWWA C110. Cast Iron fittings shall be designed for a working pressure equal to or greater than that of the pipe it is being used with.

B. ASTM D2241:

- 1. Where called for in the bid schedule or where required for on plans, PVC pipe shall meet the requirements of ASTM D2241. Standard Dimension Ratio of the pipe shall be as follows.

Pressure Class	Std. Dimension Ratio
160	26
200	21

- 2. Pipe and fitting joints of size 2 inches in diameter and larger shall be slip joint, O-ring type joints. Pipe and fitting joints smaller than 2 inches in diameter may be O-ring type or solvent cement.



3. Fittings for slip joint pipe 2 inches and larger shall be Cast Iron conforming to AWWA C110. Cast Iron fittings shall be designed for a working pressure equal to or greater than that of the pipe it is being used with. Fittings smaller than 2 inch in diameter shall be of the same material as the pipe and shall be designed for a working pressure of at least 50 psi greater than that of the pipe.

## 2.1 PVC GRAVITY PIPE AND FITTINGS:

### A. ASTM D3034:

1. Where called for in the bid schedule or where required for on plans, PVC pipe shall meet the requirements of ASTM D3034. Standard Dimension Ratio of the pipe shall not exceed 35.
2. Pipe and fitting joints of size 2 inches in diameter and larger shall be compressed elastomeric gasket joints. The bell shall consist of an integral wall section with gasket to insure positive seal slip joint, O-ring type joints. Pipe and fitting joints smaller than 2 inches in diameter may be O-ring type or solvent cement.

### B. Schedule 40 PVC:

1. Where called for in the bid schedule or where required in the plans, Schedule 40 PVC gravity drain pipe shall meet the requirements of ASTM D1785.
2. Pipe and fitting joints of size larger than 6 inches in diameter and larger shall be compressed elastomeric gasket joints. The bell shall consist of an integral wall section with gasket to insure positive seal slip joint, O-ring type joints. Pipe and fitting joints 6 inches in diameter and smaller may be O-ring type or solvent cement weld type.
3. Fittings for schedule 40 drain pipe shall be PVC Plastic Fittings, Schedule 40 meeting the requirements of ASTM S 2466.

## PART 3: EXECUTION

### 3.1 PRESSURE PIPE

- A. Fittings. All fittings shall be blocked in accordance with the standard details. All newly laid pipe shall be subjected to a hydrostatic pressure test.
- B. Connections. Joints between PVC pressure pipe and vitrified clay, PVC sewer, or other gravity pipe shall be made with special adapters as approved.
- C. Tapping of PVC Pipe. Water service connections shall be made using bronze service clamps. Coupling shall be provided with factory installed brass bushings conforming to ASTM B62 and AWWA C800.

### 3.2 SEWER PIPE

- A. PVC sewer pipe shall be installed in accordance with the standard details and with ASTM D2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe, latest edition. Bedding material shall be of the type specified in Section 02221 and shall be compacted accordingly by hand and/or mechanical methods to the depth as shown on standard details.
- B. Thirty days after backfill operations, PVC sewer pipe shall be measured for vertical deflection using a deflection testing mandrel. Maximum ring deflection of the installed pipe shall be limited to 5% of the average inside diameter as defined by ASTM D2680. All pipe exceeding the allowable deflection shall be replaced by the Contractor at no additional cost to the Owner.

END OF SECTION



## SECTION 33 11 13.06 - HDPE POTABLE WATER PIPE

### PART 1: GENERAL

- 1.01 SCOPE: The work in this section consists of providing High Density Polyethylene (HDPE) pipe and fittings.
- 1.02 RELATED WORK SPECIFIED ELSEWHERE: Utility Trenching and Backfilling – Section 31 23 33. Valves – Section 33 12 16. Disinfection – Section 33 13 00 Testing – Section 01 45 34
- 1.03 QUALITY ASSURANCE: References, American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Federal Specifications (FS), International Standards Organization (ISO), and manufacturer's printed recommendations.
- 1.04 SUBMITTALS: Material list naming each product to be used identified by manufacturer and type number.
- 1.05 PRODUCT HANDLING: Handle pipe and fittings to insure delivery in a sound undamaged condition.
- 1.06 JOB CONDITIONS: Do not lay pipe when trenches or weather conditions are not suitable for such work.

### PART 2: MATERIALS

#### 2.01 PIPE:

- A. 3 Inches and Smaller – Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-02 with a cell classification of PE:345464C. Pipe shall have a manufacturing standard of ASTM D2737 (CTS). Pipe shall be DR 9 (200psi WPR) unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, and per AWWA C901, have nominal burst values of three times the Working Pressure Rating (WPR) of the pipe. Pipe shall also have the listing of NSF 61.
- B. 4 Inches and Larger - Pipe shall be manufactured from a PE 3408 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350 with a cell classification of PE:345464C. Pipe O.D. sizes 4" to 24" shall be available in both steel pipe sizes (IPS) and ductile iron pipe sizes (DIPS). Pipe O.D. sizes 26" to 54" shall be available in steel pipe sizes (IPS). Pipe shall be DR 9 (200psi WPR) for pipe sizes up to 36" unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, listed as NSF 61, and per AWWA C906 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe.

#### 2.02 FITTINGS:

- A. Butt Fusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02, and approved for AWWA use. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a

graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.

- B. Electrofusion Fittings - Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.
- C. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D3261. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All adapters, fittings, etc. shall be restrained type to insure that hdpe pipe does not pull out. Additionally, the use of weld on collars, flanges, embedded in concrete to resist thrust shall be installed when required.

### PART 3: EXECUTION

#### 3.01 GENERAL:

- A. Pipe and Fittings: Size as indicated on the plans. Install as shown in accordance with manufacturer's recommendations.

3.02 HAULING, UNLOADING and DISTRIBUTING PIPE: During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. During transportation each pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Any pipe damaged shall be replaced.

3.03 EXCAVATION AND TRENCHING: Section 02321. Prepare trench, backfill and compact in accordance with appropriate specifications. Do not exceed manufacturer's recommended cold bend radius.

#### 3.04 FUSION:

- A. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
- B. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.
- C. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a

Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring.

D. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

3.05 INSPECTION: Inspect the pipe for defects before installation and fusion. Defective, damaged or unsound pipe will be rejected.

3.06 TESTING: Pressure testing shall be conducted in accordance with Section 02518, Testing of Piping Systems. For safety reasons, hydrostatic testing only will be used.

3.07 DISINFECTION: In accordance with Section 331300.

## SECTION 33 12 16 - VALVES

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Furnishing and installing curb stops, drains, valves, and fittings with valve boxes.
- B. Related Sections

#### 1.2 SUBMITTALS

- A. General: Submittals shall be according with the following.
- B. Manufacturer's Literature: Submit six copies of the manufacturer's descriptive data for the curb stops, valves, and service boxes to be used on this project.
- C. Installation Instructions: Submit six copies of the manufacturer's installation instructions for the curb stops, valves, and service boxes to be used on this project.
- D. Shop Drawings: Submit six copies of shop drawings of the major assemblies and components to be used on this project. A bill of materials shall be furnished with the shop drawings.

### PART 2: PRODUCTS

#### 2.1 VALVES

- A. Curb Stops: When specified on the drawings, shall be of standard design, inverted key type curb stops, 125 pound, sizes as indicated on the drawings. Curb stops shall be as manufactured by Ford Meter Box Co. or approved equal.
- B. Ball Valves: Ball valves, when specified or required shall be thermoplastic, manufactured of PVC, with EPDM seats and seals. Valves shall have a minimum pressure rating 150 psi and be the same nominal size as the connecting pipeline, unless otherwise noted on the drawings. Ball valves shall be 1/4-turn from fully open to fully closed, equipped with totally enclosed manual operators, open-closed indicator, and with operating nut suitable for operation with a wrench through the valve box as specified herein. Required force for valve operation shall be no more than 15-foot pounds when line pressure is 50 psig. Ball valves shall be ported such that headloss through the valve is less than that through 10 lineal feet of new PVC piping of the same nominal size. Ball valves shall be Allis-Chalmers, Henry Pratt, or Williamette Iron & Steel or equal.
- C. Gate Valves:
  - 1. Gate valves, 3-inch and smaller shall feature iron body, rated for 250 lb SWP, non-rising stem, "O" ring stem seal using resilient synthetic rubber, inside screw and solid wedge, 2-inch square operating nut.
  - 2. Gate valves, where double disc-parallel seat type gate valves are specified or required, shall conform to and be tested in accordance with the AWWA Standard for Gate Valves 3-inch through 48-inch for water and other liquids, AWWA C-500. Valves shall have double disc parallel seats, non-rising stems, vertical mounting "O" ring stem seal, counter-clockwise opening, and ends to fit the pipe or fitting to which attached, either push-on, mechanical, or flanged connection. Double disc-parallel seat gate valves shall be Crane, Darling, Ludlow-Rensselaer, M & H, Mueller, Smith or equal.

Gate valves, where resilient seat gate valves are specified or required, they shall conform to and be tested in accordance with the AWWA standard for Resilient Seated Gate Valves, 3-inch through 12-inch, Water and Sewer Systems, AWWA C-509. The valve

shall be bubble tight from either direction at a rated design working pressure of 200 psi. The valve shall have a single disc gate with synthetic rubber or rubber-seat bonded or mechanically attached to the disc; non-rising stem; counter clockwise opening, "O" ring stem seals; corrosion resistant interior thermoset epoxy coating acceptable for potable water; and ends to fit the pipe or fitting to which attached. Valve body shall be epoxy coated. Resilient seat gate valves shall be American, Mueller, Waterous, Clow, Kennedy, or equal.

- D. Ball-Type Check Valves: Where ball type check valves are specified for sewer service, the valve shall consist of three components: body, cover and ball – one moving part. The design shall be such that it keeps solids, stringy material, grit, rags, etc., moving through the valve without the need for back flushing. The ball shall clear the water way providing "full flow" equal to the nominal size of the pipe. It shall be non-clog. The ball shall be hollow steel with an exterior of nitrile rubber, it shall be resistant to grease, petroleum products, fats, diluted concentrations of acids and alkalines, tearing and abrasion. The body and cover shall be of gray cast iron, Class 35. Flange drilling shall be in accordance with ANSO B16.1, Class 125.
- E. Swing-Type Check Valves (2-1/2 inch and smaller): Bronze, body, renewable disc, screwed cap, rated 200 PSI as manufactured by Walworth, Houston, TX; Powell, Cincinnati, OH; or approved equal.
- F. Swing Check Valves (2-1/2inch and larger): Where swing type check valves are specified or required for water or wastewater service, they shall conform to and be tested in accordance with the AWWA standard for Swing Check Valves for Ordinary Water Works Service, AWWA C-508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Disc faces and seat rings shall be bronze. Ends shall fit the pipe or fitting to which attached. Cast iron body and cover, rated for 250 psi working pressure; external lever and weight, manufactured by Crane, Darling, M & H, Mueller, Smith; Apco, or equal.
- G. Plug Valves: When specified or required, plug valves shall be of the non-lubricated, eccentric type, cast iron body with end type as shown on the drawings. Port area shall be at least 80 percent of the cross sectional area of the same nominal pipe size. Body shall be of Gray Cast Iron, ASTM A126, Class B with resilient plug facings of neoprene for applications up to 189°F. Packings shall be BUNA (VEE) and be adjustable or replaceable without disassembly of valve. Bearing shall be stainless steel or bronze as required. Plug valves shall be as manufactured by DeZurik, Clow or equal. All plug valves of same type, style and duty shall be of one manufacturer.
- J. Air Relief Valve:
1. Where air relief valves are specified or required for water service, the valve shall be heavy duty combination air release and vacuum type for 300 psi water working pressure, tested to 300 psi, of the specified size. Body, cover and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze and the inside of the valve coated with rust inhibitor. Valve shall include special float enclosed in the valve body, with attached lever for opening and closing the air intake or discharge port. A bolted flange top shall provide access to the ball float and interior vent seat. The assembly shall not leak nor shall the valve stick under service conditions. All working parts of the valve shall be made of a non-corrosive material. Air relief valves for water service shall be as manufactured by APCO, Darling, Crispin, Val-Matic, or equal.
  2. Where air relief valves are specified or required for wastewater service, the valve shall be heavy duty sewage combination air release and vacuum release type. Valve shall be designed for a working pressure of 150 psi, the body and cover shall be constructed of cast iron with stainless steel trim and float with Buna-N seat for positive seating.
- K. Pressure Reducing Valves:

1. Pressure Reducing Valves (2-inches and larger). Where specified or required pressure reducing valves 2-inches and larger shall be a pilot controlled, hydraulically operated, diaphragm-actuated globe or angle valve capable of maintaining a constant downstream pressure, regardless of inlet pressure to the valve. The pilot control shall be a direct-acting, adjustable spring-loaded, normally open diaphragm valve. The main valve body shall be constructed of cast iron. All internal metal parts shall be constructed of either high quality stainless steel or bronze. Unless otherwise specified, all pressure reducing valves 2-inch and larger shall be furnished with 250# ANSI flanged ends.

2. Pressure reducing valves (less than 2-inches). Where specified or required pressure reducing valves shall be spring controlled, piston and cylinder type valves capable of maintaining a constant downstream pressure regardless of the inlet pressure. The main body of the valve shall be constructed of either cast iron or bronze. All internal parts shall be of either high grade stainless steel or bronze. Unless otherwise specified, all valves shall be supplied with screw ends (NPT).

## 2.2 ACCESSORIES

A. Tools: Furnish curb stop box valve keys, shut-off rods, or other tools to operate curb stops, valves and open the top of valve boxes. A minimum of one of each such tool shall be furnished for each style and size installed.

B. Valve Boxes: Valve boxes, where called for, shall include furnishing and installing of valve boxes at the locations shown on the Drawings. The AWWA Standard for the Installation of Gray and Ductile Cast Iron Water Mains, AWWA C600 shall govern the installation as applicable. Exposed parts of valve boxes shall be given one coat of rust inhibitive primer and one finish coat of yellow rubber base paint. Castings for valve boxes shall conform to and be tested in accordance with the specifications for Gray Cast Iron, ASTM A48, Class 30. Standard valve box shall consist of a 5-1/4 inch shaft and drop lid, screw type valve box. Extensions

## PART 3: EXECUTION

### 3.1 INSTALLATION

A. Valves General: Shall be installed so that each will function freely and no parts are strained.

B. Pipe Connections: Connect as shown using a cast iron adapter. Extend metallic piping sufficiently beyond the outside face of the box to permit ready connection. Extend a minimum of 5 feet from center of valve box.

C. Curb Stops: Install on the lines indicated on the drawings; set plumb on a firm base. Foreign matter shall be removed from the interior prior to installation.

D. Thrust Blocks: Provide concrete thrust blocks at changes in direction of the piping, under gate valves], and other accessories with the bearing surface against undisturbed soil normal to the direction of the thrust.

E. Valves and Valve Boxes: Valves and valve boxes shall be set plumb, with valve boxes centered directly over the valves and base section firmly screwed to stop or resting on cast iron foot piece, cement block, or compacted backfill. Set top section to allow equal movement above and below finished grade. Final elevation to be as approved by the Contracting Officer. Valve boxes shall be located outside the area of the roads and streets whenever possible. Earth fill shall be tamped around the valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Clean foreign matter from interior of valves before installation. Stuffing boxes shall be tightened and the valve shall be inspected in open and closed positions to ensure that the parts are in proper working order.

### 3.2 FIELD QUALITY CONTROL



A. Testing: Section 01 45 34 - Testing of Piping Systems.

### 3.3 CLEANING

A. Disinfection: Section 33 13 00 - Disinfection of Water Distribution.

END OF SECTION

## SECTION 33 12 19 - HYDRANTS

### 1.0 GENERAL

#### 1.1 SCOPE

Work under this heading shall include the furnishing of all labor, materials and equipment necessary to complete the assembly and installation of operable fire hydrants, flush hydrants, yard (bury) hydrants as shown on the Drawings and described herein.

#### 1.2 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the site in the manufacturer's original packaging with all labels and place markings intact.
- B. Materials shall be stored and secured off the ground in such a manner that they will not be damaged from contact with other materials or equipment.

### 2.0 PRODUCTS

#### 2.1 MANUFACTURERS/SUPPLIERS

The equipment and supplies specified in this Section shall be manufactured and/or supplied by American-Darling, East Jordan Iron Works, AVK, or equal.

#### 2.2 FIRE HYDRANTS

- A. Fire hydrants shall be of the dry-top, traffic model design type; conforming to the AWWA Standard for Dry-Barrel Fire Hydrants (AWWA C502). Fire hydrants shall have breakable connection features and shall have the following selective and design specifications. Fire hydrants shall be American-Darling B-62-B, East Jordan Iron Works Model 5CD250, AVK Type 27/80 or equal (3-way hydrants); and Mueller A411, M&H Style 133, or equal (1-way).

Working Pressure:	150 psi
Bury Depth:	3'0" minimum or as required by Drawings
Inlet Connection:	6" (standard bell or mechanical joint)
Valve Opening Size:	5-1/4"
Turn to Open Direction:	Left (counter-clockwise)
Operating Nut:	1-1/2" pentagon
Nozzle Cap Nuts:	1-1/2" pentagon
Hose Connections:	
3-way	2 - 2-1/2" and 1 - 4-1/2"
2-way	2 - 2-1/2"
1-way	1 - 2-1/2"
Nozzle Attachment to Barrel:	Threaded
Operating Nut Material:	All Bronze
Upper Valve Plate Material:	Bronze
Seat Ring Material:	Bronze
Seat Ring Thread Engagement:	Bronze to Bronze
Bonnet Weather Cap:	Required
Bonnet Lubrication Point:	Externally Accessible
Drain Valve:	Required
Color above Ground:	Red or as directed by Owner

Pumper Nozzle Threading: Contractor to verify with Owner  
Hose Nozzle Threading: Contractor to verify with Owner

- B. Where fire hydrant extensions are specified or required, they shall be of the proper design to accommodate the brand of fire hydrant installed. Extensions will be paid for separately only if included in the Bid Schedule.
- C. Nozzle threads shall be determined by the Contractor through coordination with the local fire department prior to ordering. This coordination/determination shall be the sole responsibility of the Contractor. Any misordered fire hydrants shall be replaced by the Contractor at no expense to the Owner.

### 2.3 YARD (BURY) HYDRANTS

- A. Yard hydrants when specifically called for in the plans shall be of the sanitary type, backflow protected, automatic draining, freezeless type. Yard hydrants shall be as manufactured by Woodford, model S3, or equal.

Max/Min Pressure: 20/100 psi  
Bury Depth: 3'0" minimum or as required by Drawings  
Inlet Connection: 1" NPT

## 3.0 EXECUTION

### 3.1 INSTALLATION

- A. All materials shall be assembled and installed in strict compliance with the manufacturer's instructions.
- B. Do not assemble or install any bent, scratched, or otherwise defaced material. Any question as to acceptability shall be addressed to the Engineer prior to assembly or installation.
- C. All materials are to be installed in a neat and workmanlike manner with all materials installed plumb and square.
- D. Fire hydrants shall be set so that the bottom of the pumper nozzle is not less than 12", nor more than 21", above the finish grade of the ground. Breakable bolts damaged in the installation shall be replaced in kind. If the Mueller hydrant is used, the oil reservoirs shall be filled before the hydrant is set. Concrete blocking shall be placed so that the drain and joints are accessible. Fire hydrant risers and stem extensions of the proper length shall be provided and installed as necessary and in accordance with the manufacturer's recommendations.

END OF SECTION

## SECTION 33 13 00 - DISINFECTION OF WATER LINES

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: The disinfection of the water system, including valves and any portions of the existing, connecting, water system interrupted by the installation or connection of the improvements. Disinfection or chlorination of water system shall be performed by the Contractor.

#### 1.2 SUBMITTALS

- A. General: Submittals shall be according with the following.
- B. Certificates of Conformance: Submit 6 copies of written certification from the supplier of the Contractor-furnished chlorine that it conforms to the requirements of this specification section.
- C. Reports: Submit six copies of reports from the testing laboratory.

#### 1.3 QUALITY ASSURANCE

- A. Testing Laboratory: Shall be certified or approved for examination of drinking water in compliance with applicable regulations of the State of Oklahoma.

#### 1.4 PROJECT RECORD DOCUMENTS

- A. Disinfection Report: Shall include the following:
  - 1. Type and form of disinfectant used.
  - 2. Date and time of disinfectant injection start time and completion time.
  - 3. Test locations.
  - 4. Initial and 24-hour disinfectant residuals (quantity in treated water) in parts per million (ppm) for each outlet tested.
  - 4. Date and time of flushing start and completion.
  - 5. Disinfectant residual after flushing in ppm for each outlet tested.
- B. Bacteriological Report: Shall include the following:
  - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
  - 2. Time and date of water sample collection.
  - 3. Name of person collecting samples.
  - 4. Test locations.
  - 5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
  - 6. Coliform bacteria test results for each outlet tested.
  - 7. Certification that water conforms, or fails to conform, to bacterial standards of the State of Oklahoma.
  - 8. Bacteriologist's signature.

### PART 2: PRODUCTS

#### 2.1 MATERIALS

- A. Calcium Hypochlorite: Shall be a commercial product having approximately 70 percent available chlorine by weight. Product shall be labeled and listed as NSF approved for use with potable water.
- B. Sodium Hypochlorite: AWWA B 300.

## 2.2 MIXES

- A. Calcium Hypochlorite: A five-percent solution shall be made by mixing 5 percent of calcium hypochlorite with 95 percent water by weight. Make into a paste, then thin to slurry by the addition of water. CAUTION: When calcium hypochlorite is used as the source of chlorine, it should be dissolved or suspended in water when introduced into solvent-welded PVC pipe. The dry chemical can react violently with solvent-welding materials. Precautions listed on the calcium-hypochlorite container shall be followed.

## PART 3: EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Verify that the piping system has been cleaned.

### 3.2 PREPARATION

- A. Testing: Prior to starting work, Test the water system and related appurtenances according to Section 01 45 34 - Testing of Piping Systems. Flush and disinfect water lines according to AWWA C 651.

### 3.3 APPLICATION

- A. Disinfection: Disinfect the water distribution system as follows:
  1. Disinfectant: Shall be chlorine in the form of a hypochlorite solution.
  2. Dosage: Chlorine concentration in solution shall be 50 to 80 ppm.
  3. Filling System: Fill the entire water system with the chlorine solution according to AWWA C 651. Open taps and valves and leave open until an odor of the disinfectant is noticeable in the water coming from the outlets. After this occurs, close the taps and valves.
  4. Testing Period: Allow disinfectant to remain in the system for approximately 24 hours. When disinfectant residual is less than 25 ppm, repeat system treatment. During the retention period, operate valves, stops, taps, and other appurtenances to assist the disinfection.
  5. Flushing: Thoroughly flush the system to remove the disinfectant from the system. Permit no more than the residual rate of incoming water, or 1.0 ppm, whichever is greater.
- B. Disposal of disinfecting solution
- C. Bacteriological Examination: The Owner will take samples according to AWWA C 651, Sections 9 and 10.

END OF SECTION

## SECTION 33 41 00 - STORM DRAINAGE

### PART 1: GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Furnishing and installing storm drainage piping and appurtenances.

#### 1.2 SUBMITTALS

- A. General: Submittals shall be according to General Conditions
- B. Manufacturer's Catalog Data: Submit three copies each of the following contractor furnished items that are to be used on this project:
  - 1. Pipe including fittings and jointing materials.
  - 2. Grout
  - 3. Mortar
  - 4. Gaskets
  - 5. Compression Joints
  - 6. Manhole Frames/Covers
  - 7. Grating and Frames
  - 8. Precast Concrete Manholes, Junction Boxes and Inlets
  - 9. Precast Concrete Base Slabs
  - 10. Concrete Block
  - 11. Bituminous Coating
  - 12. Cold Bituminous Mastic Sealer
- C. Installation Instructions: Submit 3 copies of manufacturer's recommendations for installation procedures of the material to be placed prior to installation.
- D. Certificates of Conformance: Submit three copies of written certification verifying that the Contractor-furnished items below conform to the requirements of this section:
  - 1. Pipe
  - 2. Grout
  - 3. Mortar
  - 4. Gaskets
  - 5. Compression Joints
  - 6. Manhole Frames/Covers
  - 7. Grating and Frames
  - 8. Precast Concrete Manholes
  - 9. Precast Concrete Base Slabs
  - 10. Concrete Block
  - 11. Bituminous Coating
  - 12. Cold Bituminous Mastic Sealer
- E. Field Test Reports: Submit three copies of quality control field tests performed in Part 3 of this section for the following:
  - 1. Compaction Test
  - 2. Infiltration Test
  - 3. Exfiltration Test
  - 4. Hydrostatic Test
- F. Work Plan: Submit 3 copies of the Work Plan when sewer flow is to be interrupted. Include the following items in the plan:
  - 1. Proposed Schedules
  - 2. Methods
  - 3. Materials

4. Equipment

- G. Samples: Submit material samples, when required by the Owners Representative.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Inspect materials delivered to site for damage; damaged goods shall be refused.
- B. Storage: Store with minimum of handling. Do not store materials directly on the ground. Store [plastic piping and jointing materials and] rubber gaskets under cover out of direct sunlight. Keep the inside of pipes and fittings free of dirt and debris.
- C. Handling: Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care not to damage coating and lining on pipe and fittings; if damaged, make repairs. Carry, do not drag pipe to trench.

PART 2: PRODUCTS

2.1 PIPE AND CULVERT MATERIALS

- A. Concrete Pipe and Fittings:
1. Reinforced concrete pipe conforming to ASTM C 76, Class III or IV .
  2. Fittings: Shall of the same strength as the pipe.
  3. Joints: Gaskets and pipe ends for rubber gasket joint shall be according to ASTM C 443. Gaskets shall be suitable for use with sewage. Provide primers and lubricants as recommended by the manufacturer. Concrete pipe joints shall be suitable for use with the joint sealants specified.
    - a. Butyl gaskets.
    - b. ASTM C 443 rubber O-ring gaskets.
    - c. AASHTO M 198, Type B preformed plastic gaskets.
    - d. Joint Mortar: ASTM C 270.
- B. Corrugated Steel Pipe and Fittings: AASHTO M 36, Types I and II.
1. Type I or II pipe with annular or helical corrugations. 16 gauge min. unless specified otherwise.
  2. Type [IR] [IIR] pipe with helical corrugations.
  3. Fabricate fittings of the same material as the pipe with strength not less than that of the pipe, and having the same size and shape of corrugations as the pipe. Helically corrugated pipe and fittings, when used with hugger-type coupling bands, shall have factory-rolled annular corrugations at each end.
  4. Jointing Devices: Coupling bands as specified in ASTM A 760. The circumference of the band shall be such that when coupled, a 3 inch (75 mm) lap will be provided.
  5. Aluminized coating, when specified, shall be in accordance with M274.
- C. ABS Composite Plastic Pipe and Fittings: Poly(Vinyl Chloride)(PVC) or Acrylonitrile-Butadiene-Styrene (ABS) composite pipe and fittings, ASTM D 2680.
1. Jointing materials: ASTM D 2680 solvent cement and primer or ASTM D 3212 elastomeric gasket joints.
- D. Polyvinyl Chloride (PVC) Plastic Piping: ASTM D 3034, SDR 35. Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.
1. Polyvinyl Chloride (PVC) Pipe Sized 15 Inch (250 mm) Diameter and Smaller: ASTM D 3034, SDR 35, with ends suitable for elastomeric gasket joints. ASTM F 949 with solvent cement joints or elastomeric gasket joints. ASTM D 3212 elastomeric gasket joints, ASTM D 2564 solvent cement joints and ASTM F 477 gaskets.
- E. Corrugated Plastic Piping: Corrugated poly(vinyl chloride) (PVC) pipe conforming to ASTM F 794 or corrugated, high density polyethylene pipe (HDPE) conforming to AASHTO M252 or

AASHTO M294. PVC fittings with solvent cemented components shall conform to ASTM D 2855 and ASTM F 402.

1. Joints and Jointing Materials: ASTM D 3212 for PVC pipe joints or manufacturer's recommendations for HDPE joints.
2. Corrugated plastic piping shall not be used in areas that will receive rigid or flexible pavements.

F. Polyethylene Piping: The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

1. Smooth Wall PE Pipe: ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches (80 to 600 mm) in diameter and maximum DR of 26 for pipes 26 to 48 inches (650 to 1200 mm) in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C. PE piping shall not be used in areas that will receive rigid or flexible pavements.
2. Corrugated PE Pipe: AASHTO M 294, Type S, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 315412C or 324420C. Pipe walls shall have the following properties:

Nominal Size	mm	inches	Minimum Wall Area (sq mm/m)	Minimum Moment of Inertia of Wall Section		
				(inches <sup>4</sup> )	mm	
300		12	3200	1.50	390	0.024
375		15	4000	1.91	870	0.053
450		18	4900	2.34	1020	0.062
600		24	6600	3.14	1900	0.116
750		30	8300	3.92	2670	0.163
900		36	9500	4.50	3640	0.222

PE piping shall not be used in areas that will receive rigid or flexible pavements.

3. Perforated Corrugated Steel Piping: ASTM A 760, Type III, zinc-coated.
4. Perforated Polyvinyl Chloride (PVC) Piping: ASTM D 2729.
5. Perforated Polyethylene Pipe With Filter: AASHTO M 252. Piping shall be heavy duty perforated corrugated polyethylene tubing having uniformly spaced slots with a maximum width of 3.17 mm (1/8 inch). Nylon filter screen shall provide covering for openings in the drain pipe. Lap seams and weld for complete coverage.
  - a. Fittings: ASTM F 405 and ASTM D 543 couplings, tees, and end caps for underdrains shall be heavy-duty polyethylene.

## 2.2 MISCELLANEOUS STRUCTURES AND MATERIALS

- A. Gravel: Underdrain trench backfill shall be pit run, screening or aggregate base and approved by the Owners Representative.
- B. Cover for Drain Outlet: Shall be 14-gauge galvanized wire mesh (1/4-inch) square opening.
- C. Hose Clamps: Shall be stainless-steel-gear type, (9/16-inch) width.
- D. Drainage Structures: Precast structures may be provided in lieu of cast-in-place concrete except for headwalls and gutters. Pipe-to-wall connections shall be mortared to produce smooth transitions and watertight joints or provided with ASTM C 923 resilient connectors. Bases shall have smooth inverts accurately shaped to a semicircular bottom conforming to the inside contour of the adjacent sewer sections. Changes in direction of the sewer and entering



branches into the manhole shall have a circular curve in the manhole invert of as large a radius as the size of the manhole will permit.

1. Precast Concrete Structures: ASTM C 478. Provide a minimum wall thickness of 5 inches (125 mm). ASTM A 615 reinforcing bars. ASTM A 497 welded wire fabric. ASTM C 443 or AASHTO M198, Type B gaskets for joint connections. Provide a 4 inch (100 mm) layer of clean gravel bedding with a maximum size of 2 inches (50 mm) or as shown on drawings..

E. Masonry Materials:

1. Brick: ASTM C 32, Grade MS, or ASTM C 62, Grade SW, except that the absorption test will be waived.
2. Concrete Masonry Units: ASTM C 139.
3. Mortar: ASTM C 270, Type M.
4. Water: Water for masonry mortar shall be fresh, clean, potable.
5. Grout: ASTM C 476.

- F. Erosion Control Riprap: Provide nonerodible rock not exceeding 15 inches (375 mm) in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness 8 inches or as indicated on drawings.

- G. Manholes, Frames, Grates and Covers: See Related Sections in Specifications/Plan Notes.

H. CATCH BASINS

1. Normal-Traffic, Precast Concrete Catch Basin: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber casketed joints.
  - a. Base Section: 6-inch (150 mm) minimum thickness for floor slab and 4-inch (100 mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
  - b. Riser Sections: 4-inch (100 mm) minimum thickness, 48-inch (1220 mm) diameter(or as required), and lengths to provide depth indicated.
  - c. Top Section: Eccentric-cone type, unless concentric-cone or flat slab top type is indicated. Top of cone of size that matches grade rings.
  - d. Gaskets: ASTM C 443 M, rubber
  - e. Grade Rings: Include two or three reinforced-concrete rings, of 6-9-inch (150 to 229 mm) total thickness, that match frame and grate.
  - f. Steps: fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12-16 inch (300-400 mm) intervals. Omit steps for catch basins less than 60 inches (1500 mm) deep.
  - g. Steps: ASTM C 478, individual steps or ladder. Omit steps for catch basins less than 60 inches (1500 mm) deep.
  - h. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
2. Heavy Duty Traffic, Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16, heavy traffic, structural loading, of depth, shape, and dimensions indicated, with provision for rubber casketed joints.
  - a. Gaskets: Rubber
  - b. Grade Rings: Include two or three reinforced concrete rings of 6-9 inch (150-229 mm) total thickness, that match frame and grate.
  - c. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps of anchor ladder into base, riser, and top section sidewalls at 12-16 inch (300-400 mm) intervals. Omit steps for catch basins less than 60 inches (1500 mm) deep.
  - d. Steps: Manufactured from deformed, 1/2 inch (13 mm) steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or

- anchor into sidewalls with steps at 12-16 inch (300-400 mm) intervals. Omit steps for manholes less than 60 inches (1500 mm) deep.
- e. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
3. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.
    - a. Bottom, Walls, and Top: Reinforced concrete
    - b. Channels and Benches: Concrete
    - c. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into sidewalls at 12-16 inch (300-400 mm) intervals. Omit steps for catch basins less than 60 inches (1500 mm) deep.
    - d. Steps: Manufactured from deformed, 1/2 inch (13 mm) steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-16 inch (300-400 mm) intervals. Omit steps for manholes less than 60 inches (1500 mm) deep
  4. Frames and Grates: ASTM A 536, Grade 60-40-18 ductile iron designed for heavy-duty service. Include flat grate with small square or short slotted drainage openings.
    - a. Size: 24 x 24 inches (610 x 610 mm) minimum, unless otherwise indicated.
    - b. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
  5. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy duty service. Include 24-inch (610 mm) ID by 7-9 inch (178-229 mm) riser with 4-inch (100 mm) minimum width flange, and 26-inch (660 mm) diameter flat grade with small square or short slotted drainage openings.
    - a. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

I. **STORMWATER INLETS**

1. Curb Inlets: Made with vertical curb opening, materials and dimensions according to utility standards.
2. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy duty frames and grates.
3. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.
4. Frames and Grates: Heavy-duty frames and grates according to utility standards.
5. Curb Inlets: Vertical curb opening, of materials and dimensions indicated.
6. Gutter Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates.
7. Combination Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.
8. Frames and Grates: Dimensions, opening pattern, free area, and other attributes indicated.
  - a. Material: ASTM A 536, Grade 60-40-18 minimum, ductile iron casting
  - b. Material: ASTM A 48, Class 30 minimum, gray iron casting.
  - c. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

J. **STORMWATER DETENTION STRUCTURES**

1. Cast In Place Concrete, Stormwater Detention Structures: Construct of reinforced concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
  - a. Ballast: Increase thickness of concrete, as required to prevent flotation.
  - b. Grade Rings: Include two or three reinforced concrete rings, of 6-9-inch (150-229 mm) total thickness, that match 24 inch (610 mm) diameter frame and cover.
  - c. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-16 inch (300-400 mm) intervals. Omit steps for structures less than 60 inches (1500 mm) deep.

- d. Steps: Manufactured from deformed, 1/2-inch (13 mm) steel reinforcement rod complying with ASTM A 615 [M] and encased in polypropylene complying with ASTM D 4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-16 inch (300-400 mm) intervals. Omit steps for structures less than 60 inches (1500 mm) deep.
2. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile iron castings designed for heavy duty service. Include 24 inch (610 mm) ID by 7-9 inch (178-229 mm) riser with 4 inch (100 mm) minimum width flange, and 26 inch (660 mm) diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover.

## PART 3: EXECUTION

### 3.1 EXCAVATION

- A. Trenching: Excavate trenches as indicated on the drawings. The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 24 inches (mm) to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Owner.
- B. Removal of Unstable Material: Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Owners Representative, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Owner.

### 3.2 BEDDING

- A. Concrete Pipe: When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type of joint.
- B. Corrugated Metal Pipe: Bedding for corrugated metal pipe and pipe arch shall be in accordance with ASTM A 798. It is not required to shape the bedding to the pipe geometry. However, for pipe arches, it is recommended to either shape the bedding to the relatively flat bottom arc or fine grade the foundation to a shallow v-shape. Bedding for corrugated structural plate pipe shall meet requirements of ASTM A 807.
- C. Plastic Pipe: Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

### 3.3 PLACING PIPE

- A. Requirements for All Pipes: Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to the direct sunlight prior to laying as needed to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or

dewatering of trenches during construction shall be provided as necessary. Deflection of installed plastic pipe shall not exceed 4.5 percent of the nominal inside diameter. After backfilling has been completed, the Owner may perform a deflection test on the entire length of installed plastic pipeline using a mandrel or other suitable device. Any plastic pipe showing deflections in excess of 4.5 percent shall be removed and replaced at the Contractor's expense. All pipe in place shall be inspected before backfilling, and those pipes damaged during placement shall be removed and replaced.

- B. Concrete Pipe: Install pipe and fittings in accordance with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9. Make joints with the gaskets previously specified for joints with this piping. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 1 inch (25 mm) of closure, remove the pipe and remake the joint.
  - 1. Elliptical and Elliptical Reinforced Concrete Pipe: Placement shall be so that the manufacturer's reference lines designating the top of the pipe will be within 5 degrees of a vertical plane through the longitudinal axis of the pipe. In all backfilling operations, care shall be taken to prevent damage to or misalignment of the pipe.
- C. ABS or PVC Composite Plastic Piping: Install pipe and fittings in accordance with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint; assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.
- D. PVC Plastic Piping: Install pipe and fittings in accordance with the requirements of ASTM D 2321 for laying and joining pipe and fittings.
- E. Corrugated Plastic Piping: Install pipe and fittings in accordance with the recommendations of the pipe manufacturer. Laying shall be with the separate sections joined firmly on a bed shaped to line and grade.
- F. Corrugated Metal Pipe and Pipe Arch: Install corrugated steel pipe, and fittings in accordance with the general requirements for installation of pipelines and with the recommendations of ASTM A 798, except as otherwise specified in the other subparagraphs hereunder.
  - 1. Pipe laying: Handle pipe carefully so as not to damage. If damage occurs, give damaged areas of pipe and couplings an application of coating equal to that specified for the pipe, as determined by the Owners Representative. Install paved invert corrugated metal pipe with the paved area centered at the bottom.
- G. Multiple Culverts: Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet (1 meter) apart, whichever is less.
- H. Subsurface Drainage Piping: The laying of pipe and tile shall proceed upgrade from the lower end of the line, and shall have a uniform pitch to the outlets. Lay drain tile with 1/8 to 1/4 inch (3 to 6 mm) open joints.

### 3.4 JOINTS

- A. Connections to Existing Lines: Notify Owners Representative in writing at least 10 days prior to date that connections are to be made. Obtain approval of the Owners Representative before interrupting service. Conduct work so that there is minimum interruption of service on existing line.
- B. Concrete Pipe:
1. Cement-Mortar Bell-and-Spigot Joint: The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be carefully cleaned with a wet brush and the lower portion of the bell filled with mortar to such depth as to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.
  2. Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe: A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket then shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space then shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.
  3. Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe: The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.
    - a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in such lengths that they will extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches (200 mm) apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.
    - b. Grout: Grout shall be poured between band and pipe from only the high side of band, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be carefully forced out by pouring and removed.
    - c. Remainder of Joint: The remaining unfilled upper portion of the joint shall then be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

4. Cement-Mortar Tongue-and-Groove Joint: The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be carefully cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned carefully with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe then shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.
  5. Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe: The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch (15 mm), thick and the width of the diaper band shall be at least 8 inches (200 mm). The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. No backfilling around the joints shall be done until the joints have been fully inspected and approved.
  6. Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe: Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions will be cut off flush with the inner surface of the pipe. If nonmastic-type sealant material is used, the "Squeeze-Out" requirement above shall be waived.
  7. Flexible Watertight Joints: Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.
  8. External Sealing Band Joint for Noncircular Pipe: Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.
- C. PVC Plastic Pipes: Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer. Assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.
- E. PE Piping:
1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.
  2. Corrugated PE Plastic Pipe: Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall

conform to ASTM F 477. Soil tight joints shall conform to the requirements in AASHTO-01, Division II, Section 26.4.2.4. (e) for soil tightness and shall be as recommended by the pipe manufacturer.

3. Profile Wall PE Plastic Pipe: Joints shall be gasketed or thermal weld type with integral bell in accordance with ASTM F 894.

F. Corrugated Metal Pipe:

1. Field Joints: Transverse field joints shall be of such design that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. In addition, the joints shall meet the general performance requirements described in ASTM A 798. The space between the pipe and connecting bands shall be kept free from dirt and grit so that corrugations fit snugly. The connecting band, while being tightened, shall be tapped with a soft-head mallet of wood, rubber or plastic, to take up slack and ensure a tight joint. The annular space between abutting sections of part paved, and fully paved pipe and pipe arch, in sizes 30 inches (750 mm) or larger, shall be filled with a bituminous material after jointing. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of fill material during the life of the installations. The type, size, and sheet thickness of the band and the size of angles or lugs and bolts shall be as indicated or where not indicated, shall be as specified in the applicable standards or specifications for the pipe.
2. Flexible Watertight, Gasketed Joints: Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall then be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket shall be closely observed to see that it is seating properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

- G. Subsurface Piping: Joints between the tile shall be covered with one thickness of the jointing material specified; material shall overlap the joint not less than 4 inches (100 mm) on each side and shall cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. [[Lay perforated clay pipe] [and] [perforated concrete pipe] without filling the pipe joints, but with positive provision for centering each section of pipe in the bell [or groove] of the placed section.] [[Perforated corrugated aluminum pipe] [and] [perforated corrugated steel pipe] shall have joints made with standard coupling bands in a manner approved by the Owners Representative.] Provide vertical pipe at the high points in each drain run, for testing purposes. Connect the vertical pipe sections into the drains by means of tees, and extend to the height indicated. Fit the upper hub ends with screwed plugs. Make joints in cast-iron sections with fiber gaskets.

### 3.5 DRAINAGE STRUCTURES

- A. Manholes: See Related Section in Specifications
- B. Walls and Headwalls: Construction shall be as indicated on the drawings.
- C. Metal Work: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron [and steel] to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined

lines and arises. Provide rabbets, lugs, and brackets wherever necessary for fitting and support.

1. Apply zinc coating to steel gratings after fabrication in accordance with ASTM A 653. Clean surfaces of steel frames and covers to bare metal. For surfaces contaminated with rust, dirt, oil, grease, or other contaminants, wash with solvents until thoroughly clean. Immediately after cleaning, coat surfaces with a coat of pretreatment coating, applied to a dry film thickness of 0.3 to 0.5 mil (0.008 to 0.013 mm); or apply a crystalline phosphate coating. If primed surfaces are damaged before removal from the shop, retouch with primer.
2. Field Painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Do not paint surfaces subject to abrasion.

### 3.6 BACKFILLING

- A. Backfilling Pipe in Trenches: After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches (150 mm) in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches (300 mm) above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches (millimeters). Tests for density will be made as necessary to ensure conformance to the compaction requirements specified elsewhere in this paragraph. Where it is necessary in the opinion of the Owners Representative, any sheeting or portions of bracing used shall be left in place and the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.
- B. Backfilling Pipe in Fill Sections: For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified elsewhere in this paragraph. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 8 inches (150 mm) in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches (300 mm) above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, (4 m), whichever is less. After the backfill has reached at least 12 inches (300 mm) above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches (mm).
- C. Movement of Construction Machinery: In compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.
- D. Compaction: Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands.
  1. Minimum Density: Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density (densities) which will be determined as specified in this paragraph.
    - a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless



material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
  - c. Under nontraffic areas, density shall be not less than that of the surrounding material.
- E. Determination of Density: Testing shall be the responsibility of the Contractor and performed at no additional cost to the Owner. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Owners Representative. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

### 3.7 FIELD TESTING

- A. Field Tests and Inspections: Contractor shall provide labor, equipment, and incidentals required for testing or engage the services of a firm to provide the necessary testing. The Owners Representative will conduct field inspections and witness field tests specified in this section. The Contractor shall be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications. Storm sewer system shall be cleaned of debris, soil, concrete, trash, etc. Examine structures and pipe for damage, displacement, shoving or misalignment, voids, proper gasket placement, embedments and visible infiltration. If, after visible inspection of the system, a suspected joint tightness problem, excessive deflection or infiltration, leakage/tightness and/or deflection testing may be required.
- B. Leakage Tests: Test lines for leakage by either infiltration tests or exfiltration tests. Prior to testing for leakage, backfill trench up to at least the lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage exceeds the amount specified below, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed:
- 1. 250 gallons per inch diameter per mile of pipeline per day ([23.5 liters per mm diameter per kilometer of pipeline per day])
  - 2. 0.2 gallons per inch diameter per 100 feet of pipeline per hour ([0.03 liters per mm diameter per 30 m of pipeline per hour])
  - 3. 500 gallons per inch of diameter per day per mile of pipeline. ([47] liters per millimeter of diameter per day per kilometer)
  - 4. Infiltration and exfiltration tests for installed concrete pipe shall be performed in accordance with ASTM C 969.
- C. Hydrostatic Test on Watertight Joints: Cement or corrugated-metal pipes joined straight shall withstand 10 psi (69 kilopascal) for 24 hours without failure. When test is completed test sections shall be angled and retested at 10 psi (69 kilopascal) for an additional 24 hours.
- 1. Test results for concrete pipe shall conform to ASTM C 443 AASHTO M 198.
  - 2. Test results for clay pipe shall conform to ASTM C 425.

- D. Low Pressure Air Test of Conduit: Acceptance tests for installed ferrous and plastic piping shall be in accordance with ASTM F 1417.
- E. Deflection Testing: Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.
  - a. Pull-through device: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.
  - b. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions.
  - c. Any pipe showing deflections in excess of 5 percent at the end of one year following installation and acceptance shall be replaced at no cost to the Owner.
- F. Field Tests for Concrete: See Field testing requirements covered in Section 03 30 53 - Structural Concrete.

END OF SECTION

# Project Manual

Bid Package 02

Volume II

Divisions 22, 23, 25, & 26

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## Cherokee Nation WILMA P. MANKILLER HEALTH CENTER EXPANSION

Stilwell, Oklahoma

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December 06, 2019





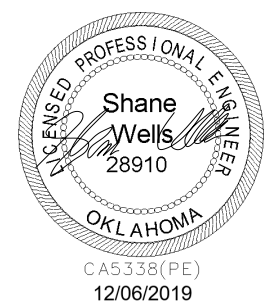
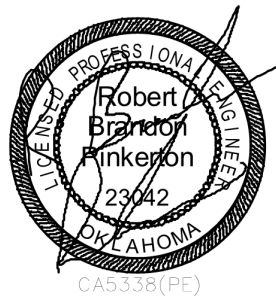


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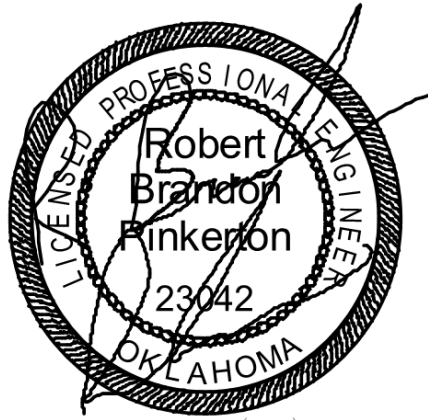
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## SECTION 22 0513

### COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

##### 1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

##### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

##### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.



- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Re-greaseable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.

3. Capacitor start, inductor run.
  4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  - C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  - D. Motors 1/20 HP and Smaller: Shaded-pole type.
  - E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION**

## SECTION 22 0516

### EXPANSION FITTINGS AND LOOPS 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. Metal-bellows packless expansion joints.
  2. Pipe loops and swing connections.
  3. Alignment guides and anchors.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of expansion joint, from manufacturer.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 PACKLESS EXPANSION JOINTS

- A. Metal-Bellows Packless Expansion Joints:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Flex Pression Ltd.
    - d. Flex-Weld, Inc.
    - e. Flo Fab inc.
    - f. Hyspan Precision Products, Inc.
    - g. Metraflex, Inc.
    - h. Twin City Hose.
  - 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  - 3. Type: Circular, corrugated bellows with external tie rods.
  - 4. Minimum Pressure Rating: 175 psig unless otherwise indicated.
  - 5. Configuration: Single joint with base and class(es) unless otherwise indicated.
  - 6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
    - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

### 2.2 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Flex-Weld, Inc.
    - d. Hyspan Precision Products, Inc.
    - e. Metraflex, Inc.
    - f. Twin City Hose.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

## **PART 3 - EXECUTION**

### **3.1 EXPANSION-JOINT INSTALLATION**

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

### **3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION**

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

### **3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION**

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
  - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION**

## SECTION 22 0517

### SLEEVES AND SLEEVE SEALS 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. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

##### 2.2 SLEEVE-SEAL SYSTEMS

- 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. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: NBR 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.

### **2.3 GROUT**

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION**

- 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, 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. Comply with requirements for sealants specified in Section 07 9200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 8413 "Penetration Firestopping."

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- 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.

### **3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
  2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
      - 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. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
  4. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION**

## SECTION 22 0518

### ESCUTCHEONS 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. Escutcheons.
  - 2. Floor plates.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

##### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
  - 2. Escutcheons for Existing Piping:
    - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
    - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
    - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
- 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: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

**3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

## SECTION 22 0519

### METERS AND GAGES 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. Liquid-in-glass thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs.
- B. Related Sections:
  - 1. Section 22 1116 "Domestic Water Piping" for water meters inside the building.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
  - 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. Flo Fab Inc.
  - b. Miljoco Corporation.
  - c. Palmer Wahl Instrumentation Group.
  - d. Tel-Tru Manufacturing Company.
  - e. Trerice, H. O. Co.
  - f. Weiss Instruments, Inc.
  - g. Winters Instruments - U.S.
2. Standard: ASME B40.200.
  3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
  4. Case Form: Adjustable angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid.
  6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
  7. Window: Glass.
  8. Stem: Aluminum or brass and of length to suit installation.
    - a. Design for Thermowell Installation: Bare stem.
  9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
  10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.2 THERMOWELLS

### A. Thermowells:

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: CNR or CUNI.
4. Material for Use with Steel Piping: CRES CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

### B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.3 PRESSURE GAGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Ernst Flow Industries.

- d. Flo Fab Inc.
- e. Marsh Bellofram.
- f. Miljoco Corporation.
- g. Noshok.
- h. Palmer Wahl Instrumentation Group.
- i. REOTEMP Instrument Corporation.
- j. Tel-Tru Manufacturing Company.
- k. Trerice, H. O. Co.
- l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- m. Weiss Instruments, Inc.
- n. WIKA Instrument Corporation - USA.
- o. Winters Instruments - U.S.

- 2. Standard: ASME B40.100.
- 3. Case: Sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Brass or Stainless steel.
- 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

- 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. Flow Design, Inc.
  - 2. Miljoco Corporation.
  - 3. National Meter, Inc.
  - 4. Peterson Equipment Co., Inc.
  - 5. Sisco Manufacturing Company, Inc.
  - 6. Trerice, H. O. Co.
  - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.



- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Inlets and outlets of each domestic water heat exchanger.
  - 3. Inlet and outlet of each domestic hot-water storage tank.
  - 4. Inlet and outlet of each remote domestic water chiller.
- J. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.

#### **3.2 CONNECTIONS**

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

#### **3.3 ADJUSTING**

- A. Adjust faces of meters and gages to proper angle for best visibility.

### **3.4 THERMOMETER SCHEDULE**

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:
  - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be the following:
  - 1. Industrial-style, liquid-in-glass type.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be the following:
  - 1. Industrial-style, liquid-in-glass type.
- D. Thermometer stems shall be of length to match thermowell insertion length.

### **3.5 THERMOMETER SCALE-RANGE SCHEDULE**

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

### **3.6 PRESSURE-GAGE SCHEDULE**

- A. Pressure gages at discharge of each water service into building shall be the following:
  - 1. Sealed, direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
  - 1. Sealed, direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
  - 1. Sealed, direct-mounted, metal case.

### **3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Water Service Piping: 0 to 160 psi.
- B. Scale Range for Domestic Water Piping: 0 to 160 psi.

**END OF SECTION**

## SECTION 22 0523

### GENERAL-DUTY 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. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron gate valves.
7. Iron globe valves.
8. Chainwheels.

- B. Related Sections:

1. Section 22 0553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 22 1113 "Facility Water Distribution Piping" for valves applicable only to this piping.
3. Section 22 1116 "Domestic Water Piping" for valves applicable only to this piping.
4. Section 22 1513 "General-Service Compressed-Air Piping" for valves applicable only to this piping.
5. Section 22 6113 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
6. Section 22 6213 "Vacuum Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
7. Section 22 6313 "Gas Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.

##### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.

- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of valve indicated.

#### **1.5 QUALITY ASSURANCE**

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.
- 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 handwheels or stems as lifting or rigging points.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL REQUIREMENTS FOR VALVES**

- A. Refer to valve schedule articles for applications of valves.

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
  - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Gate Valves: With rising stem.
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Grooved: With grooves according to AWWA C606.
  - 3. Solder Joint: With sockets according to ASME B16.18.
  - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Nonmetallic Disc:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Valve, Inc.
    - b. NIBCO INC.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. CWP Rating: 200 psig.
    - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    - d. Ends: Threaded.
    - e. Stem: Bronze.
    - f. Disc: PTFE or TFE.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Valve, Inc.
    - b. Conbraco Industries, Inc.; Apollo Valves.
    - c. Crane Co.; Crane Valve Group; Crane Valves.
    - d. Hammond Valve.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.
    - e. Body Material: Bronze.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Bronze.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.

## 2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Conbraco Industries, Inc.; Apollo Valves.
    - b. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
    - c. Crane Co.; Crane Valve Group; Jenkins Valves.
    - d. Crane Co.; Crane Valve Group; Stockham Division.
    - e. Hammond Valve.
    - f. Milwaukee Valve Company.
    - g. NIBCO INC.
    - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-67, Type I.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    - e. Seat: EPDM.
    - f. Stem: One- or two-piece stainless steel.
    - g. Disc: Aluminum bronze.

## 2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 4.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: PTFE or TFE.

## 2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. NIBCO INC.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Composition.
  - g. Seat Ring: Bronze.
  - h. Disc Holder: Bronze.
  - i. Disc: PTFE or TFE.
  - j. Gasket: Asbestos free.

## 2.7 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Disc: Solid wedge.
  - g. Packing and Gasket: Asbestos free.

## 2.8 IRON GLOBE VALVES

### A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

## 2.9 CHAINWHEELS

- ### 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. Babbitt Steam Specialty Co.
  2. Roto Hammer Industries.
  3. Trumbull Industries.



- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to butterfly valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
  - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## **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 chainwheels on operators for butterfly, gate, and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.

### **3.3 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS**

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, or gate valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe, ball, or butterfly valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  - 5. For Steel Piping, NPS 5 and Larger: Flanged ends.

### **3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE**

- A. Pipe NPS 2 and Smaller:
  - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Bronze Angle Valves: Class 125, nonmetallic disc.
  - 3. Ball Valves: Two piece, full port, bronze with bronze trim.
  - 4. Bronze Swing Check Valves: Class 125, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
  - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
  - 3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
  - 4. Iron Gate Valves: Class 125, NRS.
  - 5. Iron Globe Valves: Class 125.

**END OF SECTION**

## SECTION 22 0529

### 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. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

- B. Related Sections:

1. Section 05 5000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 22 0516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

##### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Pipe stands.
  - 4. Equipment supports.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

## **1.7 QUALITY ASSURANCE**

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## **PART 2 - PRODUCTS**

### **2.1 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 or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 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. Copper Pipe 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.

### **2.2 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

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. Allied Tube & Conduit.
  - b. Cooper B-Line, Inc.
  - c. Flex-Strut Inc.
  - d. GS Metals Corp.
  - e. Thomas & Betts Corporation.
  - f. Unistrut Corporation; Tyco International, Ltd.
  - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel 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.

## 2.4 THERMAL-HANGER SHIELD INSERTS

### 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. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. 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.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient

air temperature.

## **2.5 FASTENER SYSTEMS**

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## **2.6 PIPE STANDS**

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Plastic.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## **2.7 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## **2.8 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.9 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, 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 HANGER AND SUPPORT INSTALLATION**

- 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 Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 A 36/A 36M, 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 framing 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.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07 7200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal 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.
- K. 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.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:



- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.2 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.

### **3.3 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded 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.

### **3.4 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.5 PAINTING**

- A. Touchup: 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. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 9123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### **3.6 HANGER AND SUPPORT SCHEDULE**

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. 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. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  5. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  6. 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.
  7. 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.
  8. 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.
9. 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.
  10. 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.
  11. 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 not necessary.
  12. 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 not necessary.
  13. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  2. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  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.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to

- structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION**

## SECTION 22 0553

### IDENTIFICATION 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. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

##### 1.4 COORDINATION

- 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.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
  - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 5. 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, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
  - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 8. 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), plus the Specification Section number and title where equipment is specified.
  
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

### **2.2 WARNING SIGNS AND 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 Color: Black.
  
- C. Background Color: Yellow.
  
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

### **2.3 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

### **2.4 STENCILS**

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Aluminum.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

### **2.5 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped



- holes for attachment hardware.
  2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. 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. Valve-tag schedule shall be included in operation and maintenance data.

## **2.6 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Yellow background with black lettering.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.3 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Section 09 9123 "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
1. Identification Paint: Use for contrasting background.
  2. Stencil Paint: Use for pipe marking.
- C. 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. Near 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. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:
  - a. Background Color: Complying with ANSI 13.1.
  - b. Letter Color: Complying with ANSI 13.1.
2. Sanitary Waste and Storm Drainage Piping:
  - a. Background Color: Complying with ANSI 13.1.
  - b. Letter Color: Complying with ANSI 13.1.

### 3.4 VALVE-TAG INSTALLATION

- 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.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches.
    - b. Hot Water: 1-1/2 inches.
  2. Valve-Tag Color:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
  3. Letter Color:
    - a. Cold Water: Black.
    - b. Hot Water: Black.

### 3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

## SECTION 22 0719

### 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. Domestic chilled-water piping for drinking fountains.
  - 5. Sanitary waste piping exposed to freezing conditions.
  - 6. Storm-water piping exposed to freezing conditions.
  - 7. Roof drains and rainwater leaders.
  - 8. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
  - 1. Section 22 0716 "Plumbing Equipment Insulation."

##### 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 attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Field quality-control reports.

## **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 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.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. 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 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## **1.8 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. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- F. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## 2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F.
  5. Color: Aluminum.
  6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).



B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
  - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
  - c. RPR Products, Inc.; Insul-Mate.
  
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
  
- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pittsburgh Corning Corporation; Pittwrap.
    - b. Polyguard Products, Inc.; Insulrap No Torch 125.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.

3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.

## 2.8 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ITW Insulation Systems; Gerrard Strapping and Seals.
    - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
  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.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. C & F Wire.

## 2.9 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers,:

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. Engineered Brass Company.
  - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
  - c. McGuire Manufacturing.
  - d. Plumberex.
  - e. Truebro; a brand of IPS Corporation.
  - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (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. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. 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 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 application and finishing.
- 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 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.
  - 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, 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 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 similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### **3.4 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, 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 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.



2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.7 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 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 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.

### **3.8 FIELD-APPLIED JACKET INSTALLATION**

#### **A. Where FSK jackets are indicated, install as follows:**

1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. 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.

### **3.9 FINISHES**

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

**3.11 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.

**3.12 PIPING INSULATION SCHEDULE:**

- A. Refer to drawings for schedule.

**END OF SECTION**

**SECTION 22 1116**  
**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. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
- B. Related Requirements:
  - 1. Section 22 1113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For transition fittings and dielectric fittings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

**1.5 FIELD CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of water service.
  - 2. Do not interrupt water service without Construction Manager's and Owner's written permission.

## **PART 2 - PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. 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.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

### **2.2 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.

### **2.3 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials:
  - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.4 TRANSITION FITTINGS

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.5 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Central Plastics Company.
    - c. Hart Industries International, Inc.
    - d. Jomar International.
    - e. Matco-Norca.
    - f. McDonald, A. Y. Mfg. Co.
    - g. Watts; a division of Watts Water Technologies, Inc.
    - h. Wilkins; a Zurn company.
  - 2. Standard: ASSE 1079.
  - 3. Pressure Rating: 125 psig minimum at 180 deg F.
  - 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Central Plastics Company.
    - c. Matco-Norca.
    - d. Watts; a division of Watts Water Technologies, Inc.
    - e. Wilkins; a Zurn company.
  - 2. Standard: ASSE 1079.
  - 3. Factory-fabricated, bolted, companion-flange assembly.
  - 4. Pressure Rating: 125 psig minimum at 180 deg F.
  - 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

### **PART 3 - EXECUTION**

#### **3.1 EARTHWORK**

- A. Comply with requirements in Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

#### **3.2 PIPING INSTALLATION**

- 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 shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 0519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 1119 "Domestic Water Piping Specialties."
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 1119 "Domestic Water Piping Specialties."
- F. Install domestic water piping level and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. 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.

- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. 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.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 0519 "Meters and Gages for Plumbing Piping."
- P. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 22 1123 "Domestic Water Pumps."
- Q. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 0519 "Meters and Gages for Plumbing Piping."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

### **3.3 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 B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 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.

### **3.4 TRANSITION FITTING INSTALLATION**

- 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.

### **3.5 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for [NPS 5] and Larger: Use dielectric flange kits.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for pipe hanger, support products, and installation in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. 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.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 6. NPS 6: 10 feet with 5/8-inch rod.
  - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### **3.7 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### **3.8 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 0553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### **3.9 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.

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
- 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### **3.11 CLEANING**

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.12 PIPING SCHEDULE**

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  - 1. Soft copper tube, ASTM B 88, Type K ASTM B 88, Type L; no joints below slab.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Soft copper tube, ASTM B 88, Type K; no joints below slab.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.
- H. Aboveground domestic water piping, NPS 5 to NPS 8, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

### **3.13 VALVE SCHEDULE**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  - 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

**END OF SECTION**

## SECTION 22 1119

### DOMESTIC WATER 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. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water-hammer arresters.
12. Trap-seal primer valves.
13. Specialty valves.

- B. Related Requirements:

1. Section 22 0519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 22 1116 "Domestic Water Piping" for water meters.
3. Section 22 3200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
4. Section 22 4300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
5. Section 22 4500 "Emergency Plumbing Fixtures" for water tempering equipment.
6. Section 22 4713 "Drinking Fountains" for water filters for water coolers.
7. Section 22 4716 "Pressure Water Coolers" for water filters for water coolers.
8. Section 22 4723 "Remote Water Coolers" for water filters for water coolers.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

#### 2.2 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Cash Acme; a division of Reliance Worldwide Corporation.
  - c. Conbraco Industries, Inc.
  - d. FEBCO; a division of Watts Water Technologies, Inc.
  - e. Rain Bird Corporation.
  - f. Toro Company (The); Irrigation Div.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

- B. Hose-Connection Vacuum Breakers:

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. Arrowhead Brass Products.
  - b. Cash Acme; a division of Reliance Worldwide Corporation.
  - c. Conbraco Industries, Inc.

- d. Legend Valve.
  - e. MIFAB, Inc.
  - f. Prier Products, Inc.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
  - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1011.
  3. Body: Bronze, nonremovable, with manual drain.
  4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  5. Finish: Chrome or nickel plated.

## 2.3 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; a division of Watts Water Technologies, Inc.
  - d. Flomatic Corporation.
  - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### B. Beverage-Dispensing-Equipment Backflow Preventers:

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. Conbraco Industries, Inc.
  - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.



6. End Connections: Threaded.

C. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

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. Cash Acme; a division of Reliance Worldwide Corporation.
  - b. Lancer Corporation.
  - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

D. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. FEBCO; a division of Watts Water Technologies, Inc.
  - c. Flomatic Corporation.
  - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.4 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

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. Cash Acme; a division of Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.
  - c. Honeywell International Inc.
  - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - f. Victaulic Company of America/ Bermad
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

## 2.5 BALANCING VALVES

### A. Memory-Stop Balancing Valves:

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. Conbraco Industries, Inc.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Hammond Valve.
  - f. Milwaukee Valve Company.
  - g. NIBCO Inc.
  - h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

### B. Automatic Flow Control Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
2. Designed specifically for use in drinking water applications, NSF/ANSI 61-G rated for commercial hot water service (temperature rated to 180F), and certified by the NSF with all wetted parts stainless steel.
3. Lead-free construction in compliance with ANS/NSF-372.
4. Series 300 stainless steel body, nickel plated brass union nut, and tamper-resistant flow cartridge 300 series stainless steel.
5. Suitable for working pressures with differential control ranges of 2 - 32 psi or 5 - 60 psi differential.
6. All wetted parts comply with NSF/ANSI Standard 372 for minimal lead content.

## 2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. Powers; a division of Watts Water Technologies, Inc.
  - e. Symmons Industries, Inc.
  - f. Acorn Mfg.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.
9. Piping Finish: Chrome plated.
10. Cabinet: Factory fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Cash Acme; a division of Reliance Worldwide Corporation.
  - b. Conbraco Industries, Inc.
  - c. Honeywell International Inc.
  - d. Lawler Manufacturing Company, Inc.
  - e. Leonard Valve Company.
  - f. Powers; a division of Watts Water Technologies, Inc.
  - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
  - i. Acorn Mfg.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

## 2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.020 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
  - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

## 2.8 OUTLET BOXES

### A. Clothes Washer Outlet Boxes:

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. Acorn Engineering Company.
  - b. Guy Gray Manufacturing Co., Inc.
  - c. IPS Corporation.
  - d. LSP Products Group, Inc.
  - e. Oatey.
  - f. Plastic Oddities.
  - g. Symmons Industries, Inc.
  - h. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
  - j. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

### B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Acorn Engineering Company.
  - b. IPS Corporation.
  - c. LSP Products Group, Inc.
  - d. Oatey.
  - e. Plastic Oddities.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

## 2.9 HOSE BIBBS

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include[ integral] wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products.
  - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Operating Keys(s): Two with each wall hydrant.

## 2.11 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.

5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.12 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

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. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Precision Plumbing Products, Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products.
  - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.13 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. Precision Plumbing Products, Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06 1000 "Rough Carpentry."
- H. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- I. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- J. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- K. Install water-hammer arresters in water piping according to PDI-WH 201.
- L. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- M. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

### **3.2 CONNECTIONS**

- A. Comply with requirements for ground equipment in Section 26 0526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

### **3.3 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Intermediate atmospheric-vent backflow preventers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Carbonated-beverage-machine backflow preventers.
  - 4. Water pressure-reducing valves.
  - 5. Calibrated balancing valves.
  - 6. Primary, thermostatic, water mixing valves.
  - 7. Manifold, thermostatic, water mixing-valve assemblies.
  - 8. Primary water tempering valves.
  - 9. Outlet boxes.
  - 10. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.5 ADJUSTING**

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

**END OF SECTION**



**SECTION 22 1123**  
**DOMESTIC WATER PUMPS**

**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. In-line, sealless centrifugal pumps.

**1.3 DEFINITIONS**

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

**1.6 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

- C. Comply with pump manufacturer's written rigging instructions for handling.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Armstrong Pumps Inc.
  - 2. Bell & Gossett Domestic Pump; ITT Corporation.
  - 3. Grundfos Pumps Corp.
  - 4. TACO Incorporated.
  - 5. WILO USA LLC - WILO Canada Inc.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
- C. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  - 2. Casing: Bronze, with threaded or companion-flange connections.
  - 3. Impeller: Plastic.
  - 4. Motor: Single speed, unless otherwise indicated.

### 2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 0513 "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

### 2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
  - 1. Type: Water-immersion temperature sensor, for installation in piping.
  - 2. Range: 65 to 200 deg F.
  - 3. Enclosure: NEMA 250,.
  - 4. Operation of Pump: On or off.
  - 5. Transformer: Provide if required.
  - 6. Power Requirement: 24 V, ac.

7. Settings: Start pump at 110 deg F and stop pump at 125 deg F.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

#### **3.2 PUMP INSTALLATION**

- A. Comply with HI 1.4.
- B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.
- C. Install thermostats in hot-water return piping.

#### **3.3 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 22 1116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
  1. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 0523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 22 1119 "Domestic Water Piping Specialties."
- D. Connect thermostats, to pumps that they control.

#### **3.4 IDENTIFICATION**

- A. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

#### **3.5 STARTUP SERVICE**

- A. Perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Check piping connections for tightness.
  3. Clean strainers on suction piping.
  4. Set thermostats, for automatic starting and stopping operation of pumps.
  5. Perform the following startup checks for each pump before starting:

- a. Verify bearing lubrication.
  - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
  - c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  7. Start motor.
  8. Open discharge valve slowly.
  9. Adjust temperature settings on thermostats.
  10. Adjust timer settings.

### **3.6 ADJUSTING**

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**END OF SECTION**

## SECTION 23 1123

### FACILITY NATURAL-GAS PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: 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.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **PART 2 - PRODUCTS**

### **2.1 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, 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 A 234/A 234M 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. 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.
- B. PE Pipe: ASTM D 2513, SDR 11.
  - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  - 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  - 4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

## 2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  - 4. Corrugated stainless-steel tubing with polymer coating.
  - 5. Operating-Pressure Rating: 0.5 psig.
  - 6. End Fittings: Zinc-coated steel.
  - 7. Threaded Ends: Comply with ASME B1.20.1.
  - 8. Maximum Length: 72 inches
  
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
  - 1. Copper-alloy convenience outlet and matching plug connector.
  - 2. Nitrile seals.
  - 3. Hand operated with automatic shutoff when disconnected.
  - 4. For indoor or outdoor applications.
  - 5. Adjustable, retractable restraining cable.
  
- C. Y-Pattern Strainers:
  - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for NPS 2 and smaller.
  - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  - 4. CWP Rating: 125 psig.
  
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
  
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
  
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.4 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. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
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 shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.



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. Lee Brass Company.
  - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. PE Ball Valves: Comply with ASME B16.40.

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. Kerotest Manufacturing Corp.
  - b. Lyall, R. W. & Company, Inc.
  - c. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig.
8. Operating Temperature: Minus 20 to plus 140 deg F.
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

G. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

## 2.5 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.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Eclipse Combustion, Inc.
  - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - e. Invensys.
  - f. Maxitrol Company.
  - g. Richards Industries; Jordan Valve Div.
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: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-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 the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and 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.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Canadian Meter Company Inc.
  - b. Eaton Corporation; Controls Div.
  - c. Harper Wyman Co.
  - d. Maxitrol Company.
  - e. 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: Nitrile rubber.
6. Seal Plug: Ultraviolet-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.

## 2.6 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. Jomar International Ltd.
  - e. Matco-Norca, Inc.
  - f. McDonald, A. Y. Mfg. Co.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - h. Wilkins; a Zurn company.
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.

## **2.7 LABELING AND IDENTIFYING**

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## **PART 3 - EXECUTION**

### **3.1 OUTDOOR PIPING INSTALLATION**

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.
  1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
  1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.
- F. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 23 0519 "Meters and Gages for HVAC Piping."

### 3.2 INDOOR PIPING INSTALLATION

- 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. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 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. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- 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.
- 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. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.

- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 22 0519 "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### **3.3 VALVE INSTALLATION**

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing 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.

### **3.4 PIPING JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  2. Cut threads full and clean using sharp dies.
  3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
  1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.

2. Bevel plain ends of steel pipe.
  3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. 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, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for pipe hangers and supports specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
  2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

### **3.6 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 according to NFPA 70.
- C. Install piping adjacent to appliances to allow 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.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### **3.7 LABELING AND IDENTIFYING**

- A. Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment" for piping and valve identification.

- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### **3.8 FIELD QUALITY CONTROL**

- A. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.9 PAINTING**

- A. Comply with requirements in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (flat).
    - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### **3.10 OUTDOOR PIPING SCHEDULE**

- A. Underground natural-gas piping shall be one of the following:
  - 1. See piping schedule on drawings.
  - 2. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
  - 3. Coat pipe and fittings with protective coating for steel piping.
- B. Aboveground natural-gas piping shall 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.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

### **3.11 INDOOR PIPING SCHEDULE**

- A. See piping schedule on drawings.

### **3.12 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground: PE valves.

### **3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.

**END OF SECTION**



## SECTION 22 1316

### 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. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.
- B. Related Sections:
  - 1. Section 22 1313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

##### 1.3 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.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 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.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. 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.

### 2.2 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.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 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. ANACO-Husky.
    - b. Dallas Specialty & Mfg. Co.
    - c. Ferco Inc.
    - d. Matco-Norca, Inc.
    - e. MIFAB, Inc.
    - f. Mission Rubber Company; a division of MCP Industries, Inc.
    - g. Stant.
    - h. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 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. ANACO-Husky.
    - b. Clamp-All Corp.
    - c. Dallas Specialty & Mfg. Co.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Stant.
    - g. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
  1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
  1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  3. Unshielded, Nonpressure Transition Couplings:
    - a. 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) Dallas Specialty & Mfg. Co.
      - 2) Fernco Inc.
      - 3) Mission Rubber Company; a division of MCP Industries, Inc.
      - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
    - b. Standard: ASTM C 1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - 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.
4. Shielded, Nonpressure Transition Couplings:
- 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) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company; a division of MCP Industries, Inc.
  - b. Standard: ASTM C 1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

### **PART 3 - EXECUTION**

#### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 2000 "Earth Moving."

#### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on 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. 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. 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. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. 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 aboveground PVC piping according to ASTM D 2665.
- O. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- P. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 22 1319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 22 1319 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 1319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."

- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

### **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. 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 OD's.
  - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. 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.
  - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  - 2. NPS 3: 48 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **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 drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Install horizontal backwater valves in pit with pit cover flush with floor.
  - 6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 22 1319 "Sanitary Waste Piping Specialties."
  - 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. 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. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 22 0553 "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 drainage 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. 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 drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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. 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. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. 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 drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### **3.10 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; coupled joints.
  - 3. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
  - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

**END OF SECTION**

## SECTION 22 1319

### 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. Floor drains.
  - 3. Air-admittance valves.
  - 4. Miscellaneous sanitary drainage piping specialties.

##### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## 1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 3000 "Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
  - 1. ASME A112.36.2M, Cast-Iron Cleanouts:
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      - 1) Josam Company.
      - 2) MIFAB, Inc.
      - 3) Smith, Jay R. Mfg. Co.
      - 4) Tyler Pipe.
      - 5) Watts Drainage Products.
      - 6) Zurn Plumbing Products Group.
    - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
    - 3. Size: Same as connected drainage piping
    - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
    - 5. Closure: Countersunk or raised-head, brass or cast-iron plug.
    - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Metal Floor Cleanouts:
  - 1. ASME A112.36.2M, Cast-Iron Cleanouts:
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      - 1) Josam Company.
      - 2) Smith, Jay R. Mfg. Co.
      - 3) Tyler Pipe.
      - 4) Watts Drainage Products.
      - 5) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Closure: Brass plug with straight threads and gasket.
7. Adjustable Housing Material: Cast iron.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Heavy Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
12. Standard: ASME A112.3.1.
13. Size: Same as connected branch.
14. Housing: Stainless steel.
15. Closure: Stainless steel with seal.
16. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass or cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access Coverplate: Round, flat, stainless-steel cover plate with screw.
8. Wall Access: Square, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Top of Body and Strainer Finish: Polished bronze.
6. Funnel: Refer to Drawings.
7. Trap Material: Cast iron.

8. Trap Pattern: Deep-seal P-trap.
9. Trap Features: Trap-seal primer valve drain connection.

### 2.3 AIR-ADMITTANCE VALVES

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. Ayrlett, LLC.
  - b. Durgo, Inc.
  - c. Oatey.
  - d. ProSet Systems Inc.
  - e. RectorSeal.
  - f. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

#### B. Stack Air-Admittance Valves:

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. Durgo, Inc.
  - b. Oatey.
  - c. Studor, Inc.
2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

### 2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

#### A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, 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 C 564, 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, Trap-Seal Primer Fittings:
  - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
  - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
  
- 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. Expansion Joints:
  - 1. Standard: ASME A112.21.2M.
  - 2. Body: Cast iron with bronze sleeve, packing, and gland.
  - 3. End Connections: Matching connected piping.
  - 4. Size: Same as connected soil, waste, or vent 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. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

- c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- E. Install fixture air-admittance valves on fixture drain piping.
  - F. Install stack air-admittance valves at top of stack vent and vent stack piping.
  - G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
  - H. Assemble open drain fittings and install with top of hub 2 inches above floor.
  - I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
  - J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
    - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
    - 2. Size: Same as floor drain inlet.
  - K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
  - L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
  - M. Install vent caps on each vent pipe passing through roof.
  - N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
  - O. Install wood-blocking reinforcement for wall-mounting-type specialties.
  - P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### **3.2 CONNECTIONS**

- A. Comply with requirements in Section 22 1316 "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 22 1413

### FACILITY STORM DRAINAGE 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. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Storm Drainage Piping: 10-foot head of water.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. 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.

### 2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service classes.
- B. Gaskets: ASTM C 564, rubber.

### 2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 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. ANACO-Husky.
    - b. Dallas Specialty & Mfg. Co.
    - c. Ferco Inc.
    - d. Matco-Norca, Inc.
    - e. MIFAB, Inc.
    - f. Mission Rubber Company; a division of MCP Industries, Inc.
    - g. Stant.
    - h. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 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. ANACO-Husky.
    - b. Clamp-All Corp.
    - c. Dallas Specialty & Mfg. Co.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Stant.
    - g. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
  1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Solvent Cement: ASTM D 2564.
  1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
  3. Unshielded, Nonpressure Transition Couplings:
    - a. 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) Dallas Specialty & Mfg. Co.
      - 2) Ferco Inc.
      - 3) Mission Rubber Company; a division of MCP Industries, Inc.
      - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
    - b. Standard: ASTM C 1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - 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.
  4. Shielded, Nonpressure Transition Couplings:

- 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) Cascade Waterworks Mfg. Co.
  - 2) Mission Rubber Company; a division of MCP Industries, Inc.
- b. Standard: ASTM C 1460.
- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

## **PART 3 - EXECUTION**

### **3.1 EARTH MOVING**

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 2000 "Earth Moving."

### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping

upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- 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 aboveground PVC piping according to ASTM D 2665.
- O. Install underground PVC piping according to ASTM D 2321.
- P. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
- Q. Plumbing Specialties:
  - 1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 22 1423 "Storm Drainage Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 22 1423 "Storm Drainage Piping Specialties."
  - 3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 22 1423 "Storm Drainage 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. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

### **3.3 JOINT CONSTRUCTION**

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Plastic, Nonpressure-Piping, Solvent-Cemented 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 OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

### **3.5 VALVE INSTALLATION**

A. General valve installation requirements are specified in Section 22 0523 "General-Duty Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Section 22 1423 "Storm Drainage Piping Specialties."

### **3.6 HANGER AND SUPPORT INSTALLATION**

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 0529 "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. 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. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  - 6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  - 2. NPS 3: 48 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- H. Install supports for vertical PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.7 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
  - 2. Install horizontal backwater valves in pit with pit cover flush with floor.
  - 3. Comply with requirements for backwater valves cleanouts and drains specified in Section 22 1423 "Storm Drainage Piping Specialties."
- 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.

### **3.8 IDENTIFICATION**

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment."

### **3.9 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. 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 storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

### **3.10 CLEANING**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### **3.11 PIPING SCHEDULE**

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 and smaller shall be the following:



1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, storm drainage piping NPS 8 and larger shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground storm drainage piping NPS 6 and smaller shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Underground, storm drainage piping NPS 8 and larger shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
  3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

**END OF SECTION**

## SECTION 22 1423

### STORM DRAINAGE 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. Roof drains.
  - 2. Miscellaneous storm drainage piping specialties.
  - 3. Through-penetration firestop assemblies.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

#### PART 2 - PRODUCTS

##### 2.1 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Josam Company.
    - b. Marathon Roofing Products.
    - c. MIFAB, Inc.
    - d. Smith, Jay R. Mfg. Co.
    - e. Tyler Pipe.
    - f. Watts Water Technologies, Inc.
    - g. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.6.4, for general-purpose roof drains.
  - 3. Body Material: Cast iron.
  - 4. Dimension of Body: Nominal 14-inch diameter.

5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Extension Collars: Required.
8. Underdeck Clamp: Required.
9. Sump Receiver Plate: Required.
10. Dome Material: Cast iron.
11. Water Dam: 2 inches high.

## 2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

### A. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

### B. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.

### C. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

## 2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

### A. Through-Penetration Firestop Assemblies:

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. ProSet Systems Inc.
2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
  - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Install expansion joints, if indicated, in roof drain outlets.
  - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
  - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
  - 3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.
- K. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- L. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- M. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

### **3.2 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 22 1413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

### **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 22 1429**

### **SUMP PUMPS**

#### **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. Submersible sump pumps.
  - 2. Sump-pump basins and basin covers.
  - 3. Packaged drainage-pump units.

##### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

##### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

##### **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

##### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

## PART 2 - PRODUCTS

### 2.1 SUBMERSIBLE SUMP PUMPS

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. ABS Pumps Inc.
    - b. Barnes; Crane Pumps & Systems.
    - c. Bell & Gossett Domestic Pump; ITT Corporation.
    - d. Goulds Pumps; ITT Corporation.
    - e. Grundfos Pumps Corp.
    - f. Little Giant Pump Co.
    - g. Pentair Pump Group; Hydromatic Pumps.
    - h. Pentair Pump Group; Myers.
    - i. Weil Pump Company, Inc.
    - j. Zoeller Company.
  2. Description: Factory-assembled and -tested sump-pump unit.
  3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
  4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
  5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron and ASTM B 584, cast bronze, semiopen design for clear wastewater handling, and keyed and secured to shaft.
  6. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
  7. Seal: Mechanical.
  8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
  9. Controls:
    - a. Enclosure: NEMA 250, Type 4X.
    - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
    - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches.
    - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
  10. Control-Interface Features:
    - a. Remote Alarm Contacts: For remote alarm interface.
    - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
      - 1) On-off status of pump.
      - 2) Alarm status.

## 2.2 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
  - 1. Material: Fiberglass or polyethylene.
  - 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
  - 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
  
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
  - 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

## 2.3 PACKAGED DRAINAGE-PUMP UNITS

- A. Packaged Submersible Drainage-Pump Units:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. ABS Pumps Inc.
    - b. Bell & Gossett Domestic Pump; ITT Corporation.
    - c. Goulds Pumps; ITT Corporation.
    - d. Grundfos Pumps Corp.
    - e. Little Giant Pump Co.
    - f. Pentair Pump Group; Hydromatic Pumps.
    - g. Pentair Pump Group; Myers.
    - h. Weil Pump Company, Inc.
    - i. Zoeller Company.
  
  - 2. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sump-pump unit.
  - 3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
  - 4. Casing: Metal.
  - 5. Impeller: Brass or thermoplastic.
  - 6. Pump Seal: Mechanical.
  - 7. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
  - 8. Power Cord: Three-conductor, waterproof cable of length required but not less than 72 inches, with grounding plug and cable-sealing assembly for connection at pump.
  - 9. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings.
  - 10. Control: Motor-mounted float switch.
  - 11. Basin: Plastic.

## 2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 22 0513 "Common Motor Requirements for Plumbing Equipment."



1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

### **PART 3 - EXECUTION**

#### **3.1 EARTHWORK**

- A. Excavation and filling are specified in Section 31 2000 "Earth Moving."

#### **3.2 EXAMINATION**

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

#### **3.3 INSTALLATION**

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

#### **3.4 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 22 1413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

#### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Perform each visual and mechanical inspection.
  2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

#### **3.6 STARTUP SERVICE**

- A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

### **3.7 ADJUSTING**

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

### **3.8 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

**END OF SECTION**

## SECTION 22 3400

### FUEL-FIRED, DOMESTIC-WATER HEATERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Commercial, power-burner, gas-fired, storage, domestic-water heaters.
  - 2. Domestic-water heater accessories.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated.
- B. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Sample of special warranty.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
  - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

## 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
1. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Three years.
      - 2) Controls and Other Components: One year(s).

## PART 2 - PRODUCTS

### 2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Power-Burner, Gas-Fired, Storage, Domestic-Water Heaters:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings by the following:
    - a. Rheem
    - b. Bradford White Corporation.
    - c. Lochinvar Corporation.
    - d. PVI Industries, LLC.
    - e. Rheem Manufacturing Company.
    - f. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
    - g. State Industries.
    - h. HTP
    - i. Bock
  2. Standard: ANSI Z21.10.3/CSA 4.3.
  3. Storage-Tank Construction: Non-ASME-code steel with 150-psig working-pressure rating.
    - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
  4. 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 complying with ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
- e. Jacket: Steel with enameled finish.
- f. Burner: UL 795 for power-burner, gas-fired, domestic-water heaters and natural-gas fuel.
- g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
- h. Temperature Control: Adjustable thermostat.
- i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction.

## 2.2 DOMESTIC-WATER HEATER ACCESSORIES

### A. Domestic-Water Compression Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. AMTROL Inc.
  - b. Flexcon Industries.
  - c. Honeywell International Inc.
  - d. Pentair Pump Group (The); Myers.
  - e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
  - f. State Industries.
  - g. Taco, Inc.
  - h. Watts.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:
  - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
  - a. Working-Pressure Rating: 150 psig.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- F. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 1/2-psig pressure rating as required to match gas supply.
- G. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- H. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
  - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
- I. Pressure Relief Valves: Include pressure setting less than domestic-water heater working-pressure rating.
  - 1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.
  - 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- J. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
- K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

### **2.3 SOURCE QUALITY CONTROL**

- A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 4000 "Quality Requirements" for retesting and reinspecting requirements and Section 01 7300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

## **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 03 3000 "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, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 0523 "General-Duty Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters according to 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 23 1123 "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 commercial-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 combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-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.
- F. 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 22 1119 "Domestic Water Piping Specialties."

- G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 22 0519 "Meters and Gages for Plumbing Piping."
- H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill domestic-water heaters with water.
- J. Charge domestic-water compression tanks with air.

### **3.2 CONNECTIONS**

- A. Comply with requirements for domestic-water piping specified in Section 22 1116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 23 1123 "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 22 0553 "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 4000 "Quality Requirements" for retesting and reinspecting requirements and Section 01 7300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

### **3.5 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

**END OF SECTION**



## SECTION 22 4100

### PLUMBING FIXTURES AND TRIM

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED:

- A. Plumbing fixtures, trim, and accessories.

##### 1.02 RELATED WORK:

- A. Section 15010 General Mechanical Requirements
- B. Section 15411 Sanitary Drain, Waste, and Vent Piping System
- C. Section 15412 Domestic Water Piping System

##### 1.03 SUBMITTALS:

- A. Submit Manufacturer's Data Sheets including rough-in requirements and installation instructions for all fixtures and accessories.

#### PART 2 - PRODUCTS

##### 2.01 PLUMBING FIXTURES:

- A. Provide only new fixtures and trim free from blemishes, scratches, discoloration or other flaws.
- B. Provide fixtures and trim as scheduled on the Drawings. Include all mounting accessories and incidental items for a complete installation.

#### PART 3 - EXECUTION

##### 3.01 PREPARATION:

- A. Verify rough-in arrangement and clean mounting surfaces prior to installation.
- B. Provide sturdy support for all fixtures and proper anchors for rough-in connections. Provide additional wood blocking as required for adequate support.

##### 3.02 INSTALLATION:

- A. Install each fixture with proper water seal trap. Furnish water closets and urinals with integral traps. Provide chrome plated brass traps, waste arms, tailpieces, and wall escutcheon plates, for all other fixtures set above floor level.
- B. Provide each fixture with an accessible chrome plated brass supply with screw driver or loose key stop, reducer, and escutcheon.
- C. Furnish drinking fountains, urinals, water closets, and other wall mounted fixtures with heavy duty approved wall carriers designed for the purpose and compatible with wall construction and thickness.
- D. Provide concealed lavatory support equal to J. R. Smith model 0700 with floor mount, rectangular 1' x 3" "Pro-Set" upright, 4" square base welded to upright adjustable sleeve, thread concealed arm.

Assemblies shall be covered with manufacturer's acid resistant coating. Miscellaneous parts shall be coated with high quality enamel paint. Locate support inside plumbing wall or chase. Provide manufacturer's arm extension adapters as required to extend through stud or concrete wall. See manufacturer for adapter sizes for the appropriate wall.

E. Install fixtures at the following mounting heights above finished floor unless indicated otherwise:

- |    |                                       |                             |
|----|---------------------------------------|-----------------------------|
| 1. | Water Closet (wall-mount type):       |                             |
|    | Standard                              | 15" to top of seat          |
|    | Handicapped                           | 17"-19" to top of seat      |
| 2. | Urinal:                               |                             |
|    | Standard                              | 22" to top of rim           |
|    | Handicapped                           | 17" to top of rim           |
| 3. | Wall Hung Lavatory:                   |                             |
|    | Standard                              | 31" to top of rim           |
|    | Handicapped                           | 34" to top of rim           |
| 4. | Drinking Fountain:                    |                             |
|    | Standard                              | 40" to top of water orifice |
|    | Handicapped                           | 36" to top of water orifice |
| *  | Flush Controls shall be 44" max. AFF. |                             |

F. Where fixtures come in contact with wall, counter, or other mounting surface, caulk with fine dental plaster or approved material for clean waterproof joint.

### 3.03 FIXTURE ROUGH-IN SCHEDULE:

- A. Refer to rough-in schedule on drawings for rough-in connection sizes.
- B. Where lavatories are supplied with cold water only, connect cold water supply to both hot and cold connections of lavatory fitting.

### 3.04 ADJUSTING:

- A. Adjust each flush valve for minimum water usage to obtain specified performance and for minimum noise.

**END OF SECTION**

## SECTION 22 4213.13

### 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.
  - 3. Toilet seats.

##### 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 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.

##### 1.4 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 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

- A. Water Closets: Floor mounted, bottom outlet, top spud.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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; Commercial Brass and Fixtures.
  - f. Sloan.
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.
  - e. Rim Contour: Elongated.
  - f. Water Consumption: 1.28 gal. per flush.
  - g. Spud Size and Location: NPS 1-1/2; top.
  - h. Color: White.
3. Bowl-to-Drain Connecting Fitting: ASTM A 1045 or ASME A112.4.3.

## 2.2 WALL-MOUNTED WATER CLOSETS

- A. Water Closets: Wall mounted, top spud, accessible.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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; Commercial Brass and Fixtures.
    - f. Sloan.
  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.
    - e. Height: Standard.
    - f. Rim Contour: Elongated.
    - g. Water Consumption: 1.28 gal. per flush.
    - h. Spud Size and Location: NPS 1-1/2; top.
  3. Support:
    - a. Standard: ASME A112.6.1M.
    - b. 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.

## 2.3 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Sloan Valve Company.

- b. Delany Products.
  - c. Zurn Industries, LLC; Commercial Brass and Fixtures.
  - d. Kohler Co.
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. Exposed Flushometer-Valve Finish: Chrome plated.
  7. Panel Finish: Chrome plated or stainless steel.
  8. Style: Exposed.
  9. Consumption: 1.28 gal. per flush.
  10. Minimum Inlet: NPS 1.
  11. Minimum Outlet: NPS 1-1/4.
- B. Lever-Handle, Piston Flushometer Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Sloan Valve Company.
    - b. Delany Products.
    - c. TOTO USA, INC.
    - d. Kohler Co.
    - e. Zurn Industries, LLC; Commercial Brass and Fixtures..
  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. Exposed Flushometer-Valve Finish: Chrome plated.
  7. Panel Finish: Chrome plated or stainless steel.
  8. Style: Exposed.
  9. Consumption: 1.28 gal. per flush.
  10. Minimum Inlet: NPS 1.
  11. Minimum Outlet: NPS 1-1/4.
- C. Hard-Wired, Solenoid-Actuator, Flushometer Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Sloan Valve Company.
    - b. Delany Products.
    - c. TOTO USA, INC.
    - d. Kohler Co.
    - e. Zurn Industries, LLC; Commercial Brass and Fixtures..
  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. Exposed Flushometer-Valve Finish: Chrome plated.
  7. Panel Finish: Chrome plated or stainless steel.
  8. Style: Exposed.
  9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

10. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

D. Battery-Powered, Solenoid-Actuator, Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Kohler Co.
  - b. Delany Products.
  - c. Sloan Valve Company.
  - d. TOTO USA, INC.
  - e. Zurn Industries, LLC; Commercial Brass and Fixtures.
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. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Battery-powered electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

## 2.4 TOILET SEATS

A. Toilet Seats:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. American Standard America.
  - b. Bemis Manufacturing Company.
  - c. Centoco Manufacturing Corporation.
  - d. Jones Stephens Corp.; Comfort Seat Brand.
  - e. Kohler Co.
  - f. Olsonite Seat Co.
  - g. TOTO USA, INC.
  - h. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Standard).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.

9. Color: White.

## **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 floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
  - 3. Install accessible, wall-mounted water closets at mounting height 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 floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
  - 4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
- 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.
  - 3. Comply with escutcheon requirements specified in Section 22 0518 "Escutcheons for Plumbing Piping."
- 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 07 9200 "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 22 1116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 1316 "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**



## SECTION 22 4716

### 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 pressure water coolers and related components.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
  - 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: Include diagrams for power, signal, and control wiring.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers 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. Filter Cartridges: Equal to 25 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

#### PART 2 - PRODUCTS

##### 2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers: Wall mounted.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Elkay Manufacturing Co.
  - b. Halsey Taylor.
  - c. Haws Corporation.
  - d. Tri Palm International, LLC; Oasis Brand.
  - e. Tri Palm International, LLC; Sunroc Brand.
  - f. Acorn Mfg.
2. Cabinet: Bi-level with two attached cabinets, [**all stainless steel**] [**vinyl-covered steel with stainless-steel top**].
  3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
  4. Control: Push bar.
  5. Drain: Grid with NPS 1-1/4 tailpiece.
  6. Supply: NPS 3/8 with shutoff valve.
  7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
  8. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    - 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.
  9. Support: ASME A112.6.1M, Type I water-cooler carrier.
- B. Pressure Water Coolers: Recessed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Elkay Manufacturing Co.
    - b. Halsey Taylor.
    - c. Haws Corporation.
    - d. Tri Palm International, LLC; Oasis Brand.
    - e. Tri Palm International, LLC; Sunroc Brand.
    - f. Acorn Mfg.
  2. Standards:
    - a. Comply with NSF 61.
    - b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
  3. Cabinet: All stainless steel.
  4. Bubbler: One, with adjustable stream regulator, located on deck.
  5. Control: Push button.
  6. Drain: Grid with NPS 1-1/4 tailpiece.
  7. Supply: NPS 3/8 with shutoff valve.
  8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
  9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    - 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.

10. Ventilation Grille: Stainless steel, located below water cooler.
11. Support: Mounting frame for attaching to substrate.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 22 0523 "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 22 0518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 07 9200 "Joint Sealants."

#### **3.3 CONNECTIONS**

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 1116 "Domestic Water Piping."
- C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 22 0523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 22 1316 "Sanitary Waste and Vent Piping."

### **3.4 ADJUSTING**

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

### **3.5 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**

## SECTION 22 6113

### COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

#### 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. Medical compressed-air piping, designated "medical air."
2. Dental compressed-air piping, designated "dental air."
3. Gas-powered-tool compressed-air piping, designated "instrument air."
4. Healthcare laboratory compressed-air piping, designated "medical laboratory air."
5. Compressed-air piping and specialties for nonmedical laboratory facilities, designated "laboratory air."

- B. Related Requirements:

1. Section 11 5313 "Laboratory Fume Hoods" for compressed-air outlets in laboratory fume hoods.
2. Section 12 3553 "Laboratory Casework" for compressed-air outlets in laboratory casework.
3. Section 12 3570 "Healthcare Casework" for compressed-air outlets in healthcare casework.
4. Section 22 1513 "General-Service Compressed-Air Piping" for general-service compressed-air piping and specialties.
5. Section 22 6119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities" for air compressors and specialties.
6. Section 22 6400 "Medical Gas Alarms" for combined medical air, vacuum, and gas alarms.

##### 1.3 DEFINITIONS

- A. Medical compressed-air piping systems include medical air, dental air, instrument air, and medical laboratory air.
- B. Nonmedical compressed-air piping systems include laboratory air piping systems.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: Signed by Installer certifying that medical compressed-air piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.
- C. Brazing certificates.
- D. Field quality-control reports.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and 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. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical compressed-air pressure outlets.
    - a. Medical Air: Equal to 10 percent of amount installed, but no fewer than one units.
    - b. Instrument Air: Equal to 10 percent of amount installed, but no fewer than one units.
  - 2. D.I.S.S. Service Connections: Furnish complete medical compressed-air pressure outlets complying with CGA V-5.
    - a. Medical Air D.I.S.S. No. 1160: Equal to 10 percent of amount installed, but no fewer than one units.
    - b. Instrument Air D.I.S.S. No. 1160: Equal to 10 percent of amount installed, but no fewer than one units.

## **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Medical Air Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
  - 2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
  - 1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system

inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. Medical air operating at 50 to 55 psig.
- B. Dental air operating at 80 to 100 psig.
- C. Instrument air operating at 175 psig.
- D. Medical laboratory air operating at 100 psig.
- E. Laboratory air operating at [50 psig] [100 psig] [125 psig] <Insert value>.

### **2.2 PIPES, TUBES, AND FITTINGS**

- A. Comply with NFPA 99 for medical air piping materials.
- B. Comply with ASME B31.1, "Power Piping," for laboratory air piping operating at more than 150 psig.
- C. Comply with ASME B31.9, "Building Services Piping," for laboratory air piping operating at 150 psig or less.
- D. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.
- E. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
- F. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- G. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
  - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, full-face type.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- H. Shape-Memory-Metal Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Aerofit, Inc.
    - b. Smart Tap, Inc.
  - 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
- I. Flexible Pipe Connectors:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Hyspan Precision Products, Inc.
    - d. Mercer Gasket & Shim, Inc.
    - e. Metraflex Company (The).
    - f. Proco Products, Inc.
    - g. Unaflex.
    - h. Universal Metal Hose; a Hyspan Co.
  - 2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
    - a. Working-Pressure Rating: 200 psig minimum.
    - b. End Connections: Plain-end copper tube.

## 2.3 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.

## 2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
  - 1. Zone-Valve Boxes:
    - a. Steel Box with Aluminum Cover:
      - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a) Allied Healthcare Products Inc.
        - b) Amico Corporation.
        - c) Ohio Medical Corporation.
    - b. Description: Formed steel box with cover, anchors for recessed mounting, holes



with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

- 1) Interior Finish: Factory-applied white enamel.
- 2) Cover Plate: Aluminum with frangible or removable windows.
- 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allied Healthcare Products Inc.; Chemetron Division.
  - b. Amico Corporation.
  - c. BeaconMedaes.
  - d. Conbraco Industries, Inc.
  - e. Marwin Valve; a division of Richards Industries.
  - f. NIBCO INC.
  - g. Ohio Medical Corporation.
  - h. Tri-Tech Medical Inc.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever type with locking device.
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allied Healthcare Products Inc.; Chemetron Division.
  - b. Amico Corporation.
  - c. BeaconMedaes.
  - d. Conbraco Industries, Inc.
  - e. Ohio Medical Corporation.
  - f. Tri-Tech Medical Inc.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

E. Safety Valves:

1. Bronze body.

2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

F. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig minimum inlet pressure.
5. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig inlet pressure.

## 2.5 MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

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

1. Allied Healthcare Products Inc.; Chemetron Division.
2. Amico Corporation.
3. BeaconMedaes.
4. Ohio Medical Corporation.
5. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
6. Tri-Tech Medical Inc.

B. General Requirements for Medical Compressed-Air Service Connections:

1. Suitable for specific medical air pressure and service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
3. Double seals that will prevent air leakage.
4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:

1. Brass housing with primary check valve.
2. Double seals that will prevent air leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Pressure Service Connections:

1. Outlets for **[medical air] [and] [instrument air]** with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

- F. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
  - 1. Medical Air: D.I.S.S. No. 1160.
  - 2. Instrument Air: D.I.S.S. No. 1160.
  
- G. Cover Plates:
  - 1. One piece.
  - 2. Aluminum or stainless steel.
  - 3. Permanent, color-coded, identifying label matching corresponding service.

## 2.6 MEDICAL COMPRESSED-AIR PRESSURE CONTROL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Healthcare Products Inc.; Chemetron Division.
  - 2. Amico Corporation.
  - 3. BeaconMedaes.
  
- B. Description:
  - 1. Steel box and support brackets for recessed roughing-in with stainless-steel or anodized-aluminum cover plate with printed operating instructions.
  - 2. Manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line-pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
  - 3. Minimum Working Pressure: 200 psig.
  - 4. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
  - 5. Pressure Gages: 0 to 300 psig.
  - 6. Service Connection: CGA V-5, D.I.S.S. No. 1160, instrument air outlet.
  - 7. Before final assembly, provide temporary dust shield and U-tube for testing.
  - 8. Label cover plate "Air Pressure Control."

## 2.7 MEDICAL COMPRESSED-AIR MANIFOLDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Healthcare Products Inc.; Chemetron Division.
  - 2. Amico Corporation.
  - 3. BeaconMedaes.
  - 4. Ohio Medical Corporation.
  - 5. Tri-Tech Medical Inc.
  
- B. Comply with NFPA 99, Chapter "Manifolds for Gas Cylinders without Reserve Supply."
  
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- D. Central Control-Panel Unit:
  - 1. Weatherproof cabinet.
  - 2. Supply and delivery pressure gages.
  - 3. Electrical alarm-system connections and transformer.
  - 4. Indicator lights or devices.
  - 5. Manifold connection.
  - 6. Pressure changeover switch.
  - 7. Line-pressure regulator.
  - 8. Shutoff valves.
  - 9. Safety valve.
  
- E. Manifold and Headers:
  - 1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.
  - 2. Designed for 2000-psig minimum inlet pressure.
  - 3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1.
  - 4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
  
- F. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
  
- G. Mounting: Wall with mounting brackets for manifold control cabinet and headers.
  
- H. Label manifold control unit with permanent label identifying compressed air and system operating pressure.
  
- I. Medical Air Manifolds: For **[four] [eight] <Insert number>** cylinders and **[55-psig] <Insert value>** line pressure.
  
- J. Instrument Air Manifolds: For **[eight] [12] <Insert number>** cylinders and **[200-psig] <Insert value>** minimum line pressure.
  
- K. Compressed-Air Cylinders: Furnished by Owner.

## **2.8 COMPRESSED-AIR-CYLINDER STORAGE RACKS**

- A. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.
  
- B. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

## **2.9 NITROGEN**

- A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
  2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
    - a. Scrub to ensure complete cleaning.
    - b. Rinse with clean, hot water to remove cleaning solution.

### **3.2 PIPING INSTALLATION**

- 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. Comply with NFPA 99 for installation of compressed-air piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install compressed-air piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. 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.

- K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 22 0519 "Meters and Gages for Plumbing Piping."
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections.
- O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 22 6313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.
- P. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- Q. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.
- R. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

### **3.3 VALVE INSTALLATION**

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on compressed-air piping where reduced pressure is required.
- F. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

### **3.4 JOINT CONSTRUCTION**

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

- B. Threaded Joints: Apply appropriate tape to external pipe threads.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
- D. Flanged Joints: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

### **3.5 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION**

- A. Install compressed-air pressure control panel in walls. Attach to substrate.
- B. Install compressed-air manifolds anchored to substrate.
- C. Install compressed-air-cylinder wall storage racks attached to substrate.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
  - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1/4: 60 inches with 3/8-inch rod.
  - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
  - 3. NPS 3/4: 84 inches with 3/8-inch rod.
  - 4. NPS 1: 96 inches with 3/8-inch rod.

5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

- J. Install supports for vertical copper tubing every 10 feet.

### **3.7 IDENTIFICATION**

- A. Install identifying labels and devices for nonmedical laboratory compressed-air piping, valves, and specialties. Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for medical compressed-air piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
1. Medical Air: Black letters on yellow background.
  2. Dental Air: Black letters on yellow background.
  3. Instrument Air: White letters on red background.
  4. Medical Laboratory Air: Black letters on yellow-and-white checkerboard background.

### **3.8 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical compressed-air piping in healthcare facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
1. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of medical gas piping and medical vacuum piping systems.
  2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
    - a. Initial blowdown.
    - b. Initial pressure test.
    - c. Cross-connection test.
    - d. Piping purge test.
    - e. Standing pressure test for positive-pressure medical compressed-air piping.
    - f. Repair leaks and retest until no leaks exist.
  3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
    - a. Standing pressure test.



- b. **[Individual-pressurization] [or] [pressure-differential]** cross-connection test.
  - c. Valve test.
  - d. Master and area alarm tests.
  - e. Piping purge test.
  - f. Piping particulate test.
  - g. Piping purity test.
  - h. Final tie-in test.
  - i. Operational pressure test.
  - j. Medical air purity test.
  - k. Verify correct labeling of equipment and components.
4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
- a. Inspections performed.
  - b. Procedures, materials, and gases used.
  - c. Test methods used.
  - d. Results of tests.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

### **3.9 FIELD QUALITY CONTROL FOR COMPRESSED-AIR PIPING IN NONMEDICAL LABORATORY FACILITIES**

- A. Testing Agency: Engage qualified testing agency to perform tests and inspections of compressed-air piping in nonmedical laboratory facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
- 1. Piping Leak Tests for Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill compressed-air piping with oil-free dry 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 filters and pressure regulators for proper operation.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

### **3.10 PROTECTION**

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

### **3.11 PIPING SCHEDULE**

- A. Connect new tubing to existing tubing with memory-metal couplings.
- B. Flanges may be used where connection to flanged equipment is required.
- C. Medical Air Piping except Instrument Air Piping Larger Than NPS 3 and Operating at More Than 185 psig: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- D. Instrument Air Piping Larger Than NPS 3 and Operating at More Than 185 psig: Type K, copper tube; wrought-copper fittings; and brazed joints.
- E. Laboratory Air Piping except Laboratory Air Piping Larger Than NPS 3 and Operating at More Than 185 psig: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- F. Laboratory Air Piping Larger Than NPS 3 and Operating at More Than 185 psig: Type K, copper medical gas tube; wrought-copper fittings; and brazed joints.
- G. Refer to piping schedule on drawings.

### **3.12 VALVE SCHEDULE**

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

**END OF SECTION**

## SECTION 22 6213

### VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

#### 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. Medical-surgical vacuum piping, designated "medical vacuum."
  - 2. Waste anesthetic gas disposal piping, designated "WAGD."
  - 3. Dental vacuum piping, designated "dental vacuum."
- B. Related Requirements:
  - 1. Section 22 6219 "Vacuum Equipment for Laboratory and Healthcare Facilities" for vacuum producers and accessories.
  - 2. Section 22 6400 "Medical Gas Alarms" for vacuum piping alarms.

##### 1.3 DEFINITIONS

- A. HVE: High-volume (oral) evacuation.
- B. WAGD: Waste anesthetic gas disposal.
- C. Medical vacuum piping systems include medical vacuum, WAGD, dental vacuum, HVE, and medical laboratory vacuum piping systems.
- D. Nonmedical laboratory vacuum piping systems include laboratory low-vacuum and laboratory high-vacuum piping systems.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: Signed by Installer certifying that medical vacuum piping materials comply with requirements in NFPA 99.

- C. Brazing certificates.
- D. Field quality-control reports.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and 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. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.
    - a. Medical Vacuum: Equal to 10 percent of amount installed, but no fewer than one units.
    - b. WAGD: Equal to 10 percent of amount installed, but no fewer than one units.
  - 2. D.I.S.S. Service Connections: Furnish complete medical vacuum suction inlets complying with CGA V-5.
    - a. Medical Vacuum D.I.S.S. No. 1220: Equal to 10 percent of amount installed, but no fewer than one units.
    - b. WAGD D.I.S.S. No. 2220: Equal to 10 percent of amount installed, but no fewer than one units.

#### **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Medical Vacuum Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.
  - 2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
  - 1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Medical vacuum operating at 30 in. Hg.
- B. WAGD operating at [14 in. Hg] [15 in. Hg] <Insert value>.
- C. Dental vacuum operating at [10 in. Hg] [12 in. Hg] <Insert value>.
- D. HVE operating at [5 in. Hg] [8 in. Hg] <Insert value>.
- E. Medical laboratory vacuum operating at [12 in. Hg] [20 in. Hg] [24 in. Hg] <Insert value>.
- F. Laboratory low vacuum operating at [12 in. Hg] [20 in. Hg] <Insert value>.
- G. Laboratory high vacuum operating at [24 in. Hg] [29 in. Hg] <Insert value>.

### 2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with NFPA 99 for medical vacuum piping materials.
- B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
- C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.
- D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
  - 1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- F. Shape-Memory-Metal Couplings:
  - 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. Aerofit, Inc.
    - b. Smart Tap, Inc.
  - 2. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

G. Flexible Pipe Connectors:

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. Flex-Hose Co., Inc.
  - b. Flexicraft Industries.
  - c. Hyspan Precision Products, Inc.
  - d. Mercer Gasket & Shim, Inc.
  - e. Metraflex Company (The).
  - f. Proco Products, Inc.
  - g. Unaflex.
  - h. Universal Metal Hose; a Hyspan Co.
2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - a. Working-Pressure Rating: 200 psig minimum.
  - b. End Connections: Plain-end copper tube.

## 2.3 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

## 2.4 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
1. Zone-Valve Boxes:
    - a. Steel Box with Aluminum Cover:
      - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a) Allied Healthcare Products Inc.
        - b) Amico Corporation.
        - c) Ohio Medical Corporation.
      - b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
        - 1) Interior Finish: Factory-applied white enamel.

- 2) Cover Plate: Aluminum with frangible or removable windows.
- 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Copper-Alloy Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allied Healthcare Products Inc.; Chemetron Division.
  - b. Amico Corporation.
  - c. BeaconMedaes.
  - d. Conbraco Industries, Inc.
  - e. Marwin Valve; a division of Richards Industries.
  - f. NIBCO INC.
  - g. Ohio Medical Corporation.
  - h. Tri-Tech Medical Inc.
2. Description: Three-piece body, brass or bronze.
3. Pressure Rating: 300 psig minimum.
4. Ball: Full-port, chrome-plated brass.
5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Allied Healthcare Products Inc.; Chemetron Division.
  - b. Amico Corporation.
  - c. BeaconMedaes.
  - d. Conbraco Industries, Inc.
  - e. Ohio Medical Corporation.
  - f. Tri-Tech Medical Inc.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

## 2.5 MEDICAL VACUUM SERVICE CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Healthcare Products Inc.; Chemetron Division.
  2. Amico Corporation.
  3. BeaconMedaes.
  4. Ohio Medical Corporation.

5. Oxequip Health Industries; a division of Allied Healthcare Products Inc.
6. Tri-Tech Medical Inc.

B. General Requirements for Medical Vacuum Service Connections:

1. Suitable for specific medical vacuum service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

C. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body inlet block.
3. Seals that will prevent vacuum leakage.
4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

D. Finishing Assembly:

1. Brass housing with primary check valve.
2. Seals that will prevent vacuum leakage.
3. Cover plate with gas-service label.

E. Quick-Coupler Suction Service Connections:

1. Inlets for medical vacuum and WAGD with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

F. D.I.S.S. Suction Service Connections:

1. Inlets complying with CGA V-5.
2. Threaded indexing to prevent interchange between services.
3. Constructed to permit one-handed connection and removal of equipment.
4. Medical Vacuum: CGA V-5, D.I.S.S. No. 1220.
5. WAGD: CGA V-5, D.I.S.S. No. 2220.

G. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

H. Cover Plates:

1. One piece.
2. Aluminum or stainless steel.
3. Permanent, color-coded, identifying label matching corresponding service.

## 2.6 NITROGEN

- A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.



## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
  2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
    - a. Scrub to ensure complete cleaning.
    - b. Rinse with clean, hot water to remove cleaning solution.

### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Comply with NFPA 99 for installation of vacuum piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install vacuum piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Provide drain leg and drain trap at end of each main and branch and at low points.
- K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each

receiver and separator. Comply with requirements in Section 22 0519 "Meters and Gages for Plumbing Piping."

- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- O. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 22 6219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.
- P. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- Q. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
- R. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
- S. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

### **3.3 VALVE INSTALLATION**

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

### **3.4 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before

assembly.

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.
- E. Flanged Joints:
  - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- F. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
  - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
  - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1/4: 60 inches with 3/8-inch rod.
  - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
  - 3. NPS 3/4: 84 inches with 3/8-inch rod.
  - 4. NPS 1: 96 inches with 3/8-inch rod.
  - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
  - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
  - 7. NPS 2: 11 feet with 3/8-inch rod.

8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

J. Install supports for vertical copper tubing every 10 feet.

### **3.6 IDENTIFICATION**

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
  1. Medical Vacuum: Black letters on white background.
  2. WAGD: White letters on violet background.
  3. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.
  4. HVE: Black boxed letters on white-and-black diagonal stripe background.
  5. Medical Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

### **3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
  1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
  2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
    - a. Initial blowdown.
    - b. Initial pressure test.
    - c. Cross-connection test.
    - d. Piping purge test.
    - e. Standing pressure test for vacuum systems.
    - f. Repair leaks and retest until no leaks exist.
  3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
    - a. Standing pressure test.
    - b. Individual-pressurization or pressure-differential cross-connection test.
    - c. Valve test.

- d. Master and area alarm tests.
  - e. Piping purge test.
  - f. Final tie-in test.
  - g. Operational vacuum test.
  - h. Verify correct labeling of equipment and components.
4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
- a. Inspections performed.
  - b. Procedures, materials, and gases used.
  - c. Test methods used.
  - d. Results of tests.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

### **3.8 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NONMEDICAL VACUUM PIPING**

- A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of vacuum piping in nonmedical laboratory facilities and to prepare test and inspection reports.
- B. Tests and Inspections:
- 1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. 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.
    - a. Test Pressure for Copper Tubing: 100 psig.
  - 2. Repair leaks and retest until no leaks exist.
  - 3. Inspect filters for proper operation.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.

### **3.9 PROTECTION**

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

### **3.10 PIPING SCHEDULE**

- A. Connect new copper tubing to existing copper tubing with memory-metal couplings.

- B. Flanges may be used where connection to flanged equipment is required.
- C. Medical Vacuum Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.
- D. WAGD Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.
- E. Dental Vacuum Piping: Use copper water tube, wrought-copper fittings, and brazed joints.

### **3.11 VALVE SCHEDULE**

- A. Shutoff Valves:
  - 1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

**END OF SECTION**

## SECTION 22 6313

### OXYGEN PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

#### 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.
- B. All information and compliance must be coordinated with Benco plans and representative.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Oxygen piping, designated "medical oxygen."
  - 2. Nitrous oxide piping, designated "medical nitrous oxide."
- B. Owner-Furnished Material:
  - 1. Patient-service consoles.
  - 2. Ceiling columns.
  - 3. Ceiling-hose assemblies.
  - 4. Medical gas manifolds.
- C. Related Requirements:
  - 1. Section 12 3570 "Healthcare Casework" for gas outlets in medical casework.
  - 2. Section 22 6400 "Medical Gas Alarms" for combined medical air, vacuum, and gas alarms.

##### 1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. Medical gas piping systems include medical oxygen and medical nitrous oxide for healthcare facility patient care.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and testing agency.
- B. Seismic Qualification Certificates: For gas manifolds, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Material Certificates: Signed by Installer certifying that medical gas piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.
- D. Brazing certificates.
- E. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
- F. Field quality-control reports.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For medical gas piping specialties to include in emergency, operation, and 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. Quick-Coupler Service Connections: Furnish complete non-interchangeable medical gas pressure outlets and suction inlets.
    - a. Medical Oxygen: Equal to 10 percent of quantity installed, but no fewer than 3 units.
  - 2. D.I.S.S. Service Connections: Furnish complete medical gas pressure outlets and suction inlets complying with CGA V-5.
    - a. Medical Oxygen D.I.S.S. No. 1240: Equal to 10 percent of quantity installed, but no fewer than 3 units.
    - b. Medical Nitrous Oxide D.I.S.S. No 1040:
    - c. WAGD D.I.S.S. No. 2220 :

## **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Medical Gas Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.



2. Bulk Medical Gas Systems for Healthcare Facilities: According to ASSE Standard #6015 for bulk-medical-gas-system installers.
  3. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. Medical oxygen operating at 50 to 55 psig. Confirm with Benco.
- B. Medical nitrous oxide operating at 50 to 55 psig. Confirm with Benco.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Medical gas manifolds and bulk medical gas storage tanks shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the medical gas manifolds will remain in place without separation of any parts when subjected to the seismic forces specified and the manifolds and tanks will be fully operational after the seismic event."

### **2.3 PIPES, TUBES, AND FITTINGS**

- A. Comply with NFPA 99 for medical gas piping materials.
- B. Copper Medical Gas Tube: ASTM B 819, Type K and Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service; or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
- C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
- D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.
- E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

## **2.4 JOINING MATERIALS**

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.
- C. Solvent Cement for Joining PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

## **2.5 VALVES**

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
  1. Zone-Valve Boxes:
    - a. Steel Box with Aluminum Cover:
      - 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - a) Allied Healthcare Products Inc.
        - b) Amico Corporation.
        - c) Ohio Medical Corporation.
    - b. Steel Box with Stainless-Steel Cover:
      - a) Allied Healthcare Products Inc.
      - b) Amico Corporation.
      - c) Ohio Medical Corporation.
    - c. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
      - 1) Interior Finish: Factory-applied white enamel.
      - 2) Cover Plate: stainless steel with frangible or removable windows.
      - 3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- C. Ball Valves:
  1. Standard: MSS SP-110.
  2. Description: Three-piece body, brass or bronze.
  3. Pressure Rating: 300 psig minimum.
  4. Ball: Full-port, chrome-plated brass.

5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Description: In-line pattern, bronze.
2. Pressure Rating: 300 psig minimum.
3. Operation: Spring loaded.
4. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

E. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.

1. Enclosure: Weatherproof hinged locking cover with caption similar to "Emergency Low-Pressure Gaseous Oxygen Inlet."
2. Inlet: Manufacturer-installed, NPS 1 or NPS 1-1/4 ASTM B 819, copper tubing with NPS 1 minimum ball valve.
3. Safety Valve: Bronze-body pressure relief valve set at 75 or 80 psig.
4. Instrumentation: Pressure gage.

F. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

G. Pressure Regulators:

1. Stainless-steel body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig minimum inlet pressure.
5. Capable of controlling delivered gas pressure within 0.5 psig for each 10-psig inlet pressure.

## 2.6 MEDICAL GAS SERVICE CONNECTIONS

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

- a) Allied Healthcare Products Inc.
- b) Amico Corporation.
- c) Ohio Medical Corporation.

B. General Requirements for Medical Gas Service Connections:

1. Suitable for specific medical gas pressure and suction service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

- C. Roughing-in Assembly:
  - 1. Steel outlet box for recessed mounting and concealed piping.
  - 2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.
  - 3. Double seals that will prevent gas leakage.
  - 4. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.
  
- D. Finishing Assembly:
  - 1. Brass housing with primary check valve.
  - 2. Double seals that will prevent gas leakage.
  - 3. Cover plate with gas-service label.
  
- E. Quick-Coupler Pressure Service Connections: Outlets for oxygen and nitrous oxide with non-interchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
  
- F. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
  - 1. Medical Oxygen: D.I.S.S. No. 1240.
  - 2. Medical Nitrous Oxide: D.I.S.S. No. 1040.
  
- G. Cover Plates: One-piece, stainless steel and permanent, color-coded, identifying label matching corresponding service.
  
- H. D.I.S.S. Pressure Service Connections: Outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
  - 1. Medical Air: D.I.S.S. No. 1160.
  - 2. Instrument Air: D.I.S.S. No. 1160.
  
- I. D.I.S.S. Suction Service Connections: Inlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
  - 1. Medical Vacuum: D.I.S.S. No. 1220.
  - 2. WAGD: D.I.S.S. No. 2220.
  
- J. Cover Plates: One piece, stainless steel and permanent, color-coded, identifying label matching corresponding service.

## 2.7 CEILING COLUMNS

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

- a. Allied Healthcare Products Inc.
- b. Amico Corporation.
- c. Ohio Medical Corporation.
2. Standard: UL 60601.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. General Requirements for Ceiling Columns: Ceiling-mounted units with service connections. Include labels indicating services.
5. Ceiling-Mounted Plate: Manufacturer's standard plate or roughing-in assembly.
6. Exposed Surfaces: Minimum 0.0375-inch- thick stainless steel.
7. Servicing: Include access panels or means of removing shroud.
8. Blank cover plates for cutouts not having service connections.
9. ASTM B 819, NPS 3/8 copper-tube extensions for connection to medical gas systems.
10. Service Connections: Type and number indicated.
11. Dust Covers: For medical gas service connections.
12. Description: Manually adjustable using release and lock handles capable of locking column in all positions from fully retracted to fully extended; 15-inch long, rectangular, counterbalanced, telescoping section with two double intravenous medication hooks; and 36-inch-long fixed column section. Include 0.078-inch-thick, stainless-steel bottom plate with medical gas and electrical service connections as required.
13. Medical Gas Service Connections: As indicated on drawings.
14. Electrical Service Connections:
  - a. General Requirements for Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - b. Power Outlets: UL 498, Hospital Grade, 125-V ac, duplex receptacle(s) in color selected by Architect. Include the following configurations complying with NEMA WD 1:

## **2.8 MEDICAL GAS MANIFOLDS**

- A. MEDICAL GAS MANIFOLDS MODULAR
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Healthcare Products Inc.
    - b. Amico Corporation.
    - c. Ohio Medical Corporation.
- B. Comply with NFPA 99 for high-pressure medical gas cylinders.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Central Control-Panel Unit:
  1. Weatherproof cabinet.
  2. Supply and delivery pressure gages.
  3. Electrical alarm-system connections and transformer.
  4. Indicator lights or devices.
  5. Manifold connection.
  6. Pressure changeover switch.

7. Line-pressure regulator.
8. Shutoff valves.
9. Safety valve.

E. Manifold and Headers:

1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks. Confirm with Benco.
2. Designed for 2000-psig minimum inlet pressure. Confirm with Benco.
3. Cylinder-bank headers with inlet (pigtail) connections complying with CGA V-1. Confirm with Benco.
4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage. Confirm with Benco.

F. Operation: Automatic, pressure-switch-activated changeover from one-cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.

G. Mounting: Wall with mounting brackets for manifold control cabinet and headers.

H. Label manifold control unit with permanent label identifying medical gas type and system operating pressure.

I. Medical Nitrous Oxide Manifolds, coordinate with Benco.

J. Medical Oxygen Manifolds, coordinate with Benco.

## 2.9 GAS CYLINDER STORAGE RACKS

A. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.

B. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

## 2.10 NITROGEN

A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to

CGA G-4.1.

2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
  - a. Scrub to ensure complete cleaning.
  - b. Rinse with clean, hot water to remove cleaning solution.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were 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. Comply with NFPA 99 for installation of medical gas piping.
- C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.
- H. Install piping to permit valve servicing.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and for branch connections.
- K. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
- L. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.
- M. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- N. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

- O. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.
- P. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 0517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 0518 "Escutcheons for Plumbing Piping."

### **3.3 VALVE INSTALLATION**

- A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
- B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on gas piping where reduced pressure is required.
- F. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.

### **3.4 JOINT CONSTRUCTION**

- A. Ream ends of PVC pipes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Threaded Joints: Apply appropriate tape to external pipe threads.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.
- E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.
- F. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according



to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 and ASTM D 2672 for solvent-cemented joints.

### **3.5 GAS SERVICE COMPONENT INSTALLATION**

- A. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.
- B. Install nitrogen pressure-control panels in walls. Attach to substrate.
- C. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
- D. Assemble ceiling-hose assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.
- E. Install gas manifolds on concrete base anchored to substrate.
- F. Install gas cylinders and connect to manifold piping.
- G. Install gas manifolds with seismic restraints.
- H. Install bulk gas storage tanks and reserve supply tanks level on concrete bases. Set tanks and connect gas piping to tanks according to applicable requirements in NFPA 50 for bulk oxygen storage systems. Install tanks level and plumb, firmly anchored to concrete bases; maintain NFPA 50 and tank manufacturer's recommended clearances. Orient tanks so controls and devices are accessible for servicing.
- I. Install bulk gas storage tanks and reserve supply tanks with seismic restraints.

### **3.6 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements in Section 22 0548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or Type 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
  1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
  2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls.

Support pipe rolls on trapeze. Comply with requirements in Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch-minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1/4 60 inches with 3/8-inch rod.
  - 2. NPS 3/8 and NPS 1/2 72 inches with 3/8-inch rod.
  - 3. NPS 3/4 84 inches with 3/8-inch rod.
  - 4. NPS 1 96 inches with 3/8-inch rod.
  - 5. NPS 1-1/4 108 inches with 3/8-inch rod.
  - 6. NPS 1-1/2 10 feet with 3/8-inch rod.
  - 7. NPS 2 11 feet with 3/8-inch rod.
  - 8. NPS 2-1/2 13 feet with 1/2-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.

### **3.7 IDENTIFICATION**

- A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Section 22 0553 "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
  - 1. Carbon Dioxide: Black or white letters on gray background.
  - 2. Helium: White letters on brown background.
  - 3. Nitrogen: White letters on black background.
  - 4. Nitrous Oxide: White letters on blue background.
  - 5. Oxygen: White letters on green background or green letters on white background.

### **3.8 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
  - 2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
    - a. Initial blowdown.
    - b. Initial pressure test.

- c. Cross-connection test.
  - d. Piping purge test.
  - e. Standing pressure test for positive-pressure medical gas piping.
  - f. Standing pressure test for vacuum systems.
  - g. Repair leaks and retest until no leaks exist.
3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:
- a. Standing pressure test.
  - b. Individual-pressurization or pressure-differential cross-connection test.
  - c. Valve test.
  - d. Master and area alarm tests.
  - e. Piping purge test.
  - f. Piping particulate test.
  - g. Piping purity test.
  - h. Final tie-in test.
  - i. Operational pressure test.
  - j. Medical gas concentration test.
  - k. Medical air purity test.
  - l. Verify correct labeling of equipment and components.
  - m. Verify medical gas supply sources.
4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
- a. Inspections performed.
  - b. Procedures, materials, and gases used.
  - c. Test methods used.
  - d. Results of tests.
- C. Remove and replace components that do not pass tests and inspections and retest as specified above.
- D. Prepare test and inspection reports.

### **3.9 PROTECTION**

- A. Protect tubing from damage.
- B. Retain sealing plugs in tubing, fittings, and specialties until installation.
- C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

### **3.10 DEMONSTRATION**

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain bulk gas storage tanks.

### **3.11 PIPING SCHEDULE**

- A. Connect new tubing to existing tubing with memory-metal couplings.
- B. Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 and Operating at More Than 185 psig Type L, copper tube; wrought-copper fittings; and brazed joints.
- C. Protective Conduit: PVC pipe, PVC fittings, and solvent-cemented joints.

### **3.12 VALVE SCHEDULE**

- A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.
- B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

**END OF SECTION**

## SECTION 22 6400

### MEDICAL GAS ALARMS

#### 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.
- B. All information and compliance must be coordinated with Benco plans and representative.

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Master alarm panels.
  - 2. Anesthetizing-area alarm panels.
  - 3. Area alarm panels.
  - 4. Dental-area alarm panels.
  - 5. Local alarm panels.

##### 1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Test Reports: For each alarm panel, for tests performed by a qualified testing agency.
- C. Field quality-control reports.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For alarm panels to include in emergency, operation, and maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Qualify Installers for air, vacuum, and gas piping systems for healthcare facilities according to ASSE Standard #6010 for medical-gas-system installers.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the air, vacuum, and gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
  - 1. Qualify testing personnel for air, vacuum, and gas piping systems for healthcare facilities according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. Gas and Vacuum Systems Monitored:
  - 1. Medical compressed air, designated "medical air."
  - 2. Medical-surgical vacuum, designated "medical vacuum."
  - 3. Oxygen, designated "medical oxygen."
  - 4. Waste anesthetic gas disposal, designated "WAGD."

### **2.2 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Healthcare Products Inc.
  - 2. Amico Corporation.
  - 3. Ohio Medical Corporation.
- B. Source Limitations: Obtain medical alarm systems and components from single manufacturer.

### **2.3 GENERAL REQUIREMENTS FOR ALARM PANELS**

- A. Description: Factory wired with audible and color-coded visible signals to indicate specified functions.
  - 1. Mounting: Exposed, surface Recessed installation.
  - 2. Enclosures: Fabricated from minimum 0.047-inch-thick steel or minimum 0.05-inch-thick aluminum, with knockouts for electrical and piping connections.
- B. Components: Designed for continuous service and to operate on power supplied from 120-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
- C. Dew Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Alarm signals when pressure dew point rises above 39 deg F at 55 psig. Confirm with Benco.

- D. Pressure Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
  - 1. Low-Pressure Operating Range: 0 to 100 psig.
  - 2. High-Pressure Operating Range: Up to 250 psig.
- E. Carbon-Monoxide Monitors: Panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, and factory- or field-installed valved bypass. Alarm signals when carbon-monoxide level rises above 10 ppm.
- F. Vacuum Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
  - 1. Vacuum Operating Range: 0 to 30 in. Hg. Confirm with Benco.

## **2.4 MASTER ALARM PANELS**

- A. Master and Alarm Panels-Separate trouble alarm signals and indicators for each system.
  - 1. Standards: Comply with NFPA 99 and UL 544.
  - 2. 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.
  - 3. Include alarm signals when the following conditions exist:
    - a. Medical Air: Pressure drops below 40 psig or rises above 60 psig backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig, dew point rises above 39 deg F at 55 psig carbon-monoxide level rises above 10 ppm, and high water level is reached in receiver for liquid-ring, medical air compressor systems. Confirm with Benco.
    - b. Medical Vacuum: Vacuum drops below 12 in. Hg and backup vacuum pump is in operation. Confirm with Benco.
    - c. WAGD: Vacuum drops below 12 in. Hg. Confirm with Benco.
    - d. Medical Oxygen: Pressure downstream from main shutoff valve drops below 40 psig or rises above 60 psig and changeover is made to alternate bank. Confirm with Benco.

## **2.5 ANESTHETIZING-AREA ALARM PANELS**

- A. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals and indicators for each system.
  - 1. Standards: Comply with NFPA 99 and UL 544.
  - 2. 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.
  - 3. Include alarm signals when the following conditions exist:
    - a. Medical Air: Pressure drops below 40 psig or rises above 60 psig. Confirm with Benco.
    - b. Medical Vacuum: Vacuum drops below 12 in. Hg. Confirm with Benco.
    - c. WAGD: Vacuum drops below 12 in. Hg. Confirm with Benco.

- d. Medical Oxygen: Pressure drops below 40 psig rises above 60 psig. Confirm with Benco.

## 2.6 AREA ALARM PANELS

- A. Area Alarm Panels: Separate trouble alarm signals and indicators for each system.
  - 1. Standards: Comply with NFPA 99 and UL 544.
  - 2. 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.
  - 3. Include alarm signals when the following condition exists:
    - a. Medical Air: Pressure drops below 40 psig or rises above 60 psi. Confirm with Benco.
    - b. Medical Vacuum: Vacuum drops below 12 in. Hg. Confirm with Benco.
    - c. Medical Oxygen: Pressure drops below 40 psig or rises above 60 psig. Confirm with Benco.

## 2.7 LOCAL ALARM PANELS

- A. Local Alarm Panels - Separate trouble alarm signals and indicators for each system.
  - 1. Standards: Comply with NFPA 99 and UL 544.
  - 2. 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.
  - 3. Include alarm signals when the following conditions exist:
    - a. Medical Air: Confirm with Benco, pressure drops below 40 psig or rises above 60 psig backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig, dew point rises above 39 deg F at 55 psig, carbon-monoxide level rises above 10 ppm, and the following:
      - 1) Air Compressor: High discharge-air temperature and high water level in receiver.
      - 2) Liquid-Ring Air Compressor: High water level in receiver and high water level in separator.
    - b. Medical Vacuum: Vacuum drops below 12 in. Hg backup vacuum producer is in operation, and high water level is in receiver.
    - c. WAGD: Vacuum drops below 12 in. Hg backup vacuum producer is in operation, and high water level is in receiver.
    - d. HVE Vacuum Equipment: Vacuum drops below 4 in. Hg, backup turbine exhaustor is in operation, and high water level is in receiver.

## PART 3 - EXECUTION

### 3.1 ALARM-PANEL INSTALLATION

- A. Install alarm panels in locations required by and according to NFPA 99.



- B. Install computer-interface cabinet with connection to alarm panels and facility computer.

### **3.2 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 22 6113 "Compressed-Air Piping for Laboratory and Healthcare Facilities," Section 22 6213 "Vacuum Piping for Laboratory and Healthcare Facilities," and Section 22 6313 "Gas Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to alarm panels, allow space for service and maintenance.

### **3.3 IDENTIFICATION**

- A. Identify system components. Comply with requirements for identification specified in Section 22 0553 "Identification for Plumbing Piping and Equipment" and according to NFPA 99.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform each visual and mechanical inspection.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning panels and equipment.
- D. Alarm panels will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### **3.6 ADJUSTING**

- A. Adjust initial alarm panel pressure and vacuum set points.

**3.7 DEMONSTRATION**

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

**END OF SECTION**

## SECTION 23 0510

### MECHANICAL COORDINATION

#### 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 administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements.

##### 1.3 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
  - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Electronic drawings provided by the architect may be used as a starting point for Coordination Drawings.
    - c. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - d. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - e. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - f. Show location and size of access doors required for access to concealed dampers, valves, and other controls.

- g. Indicate required installation sequences.
- h. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling, raised access floor, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
  - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
  - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
  - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
  - a. Runs of vertical and horizontal conduit 1 inch and larger in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
  - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
  - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 3300 "Submittal Procedures."

- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Revit 2016 version.
  2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format and PDF format.
  3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
    - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
  4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in Revit 2016 version.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION**

## SECTION 23 0513

### COMMON MOTOR REQUIREMENTS FOR HVAC 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

##### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

##### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
  2. Split phase.
  3. Capacitor start, inductor run.
  4. Capacitor start, capacitor run.
- B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION**



## SECTION 23 0514

### VARIABLE FREQUENCY MOTOR CONTROLLERS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency Drive (VFD aka: VFC, VSD, AFD, ASD, Inverter, AC Drive) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.
  - 1. Applications: Constant and variable torque for fans, blowers, and pumps.
- B. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFDs that are manufactured by a third party and "brand labeled" shall not be acceptable. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a "brand labeled" drive. All VFD assemblies installed on this project shall be from the same manufacturer.

##### 1.02 QUALITY ASSURANCE

- A. Referenced Standards and Guidelines:
  - 1. Institute of Electrical and Electronic Engineers (IEEE)
    - a. IEEE 519-1992, Guide for Harmonic Content and Control.
  - 2. Underwriters Laboratories (as appropriate)
    - a. UL508
    - b. UL508A
    - c. UL508C
  - 3. National Electrical Manufacturer's Association (NEMA)
    - a. ICS 7.0, AC Adjustable Speed Drives
  - 4. International Electrotechnical Commission (IEC)
    - a. EN/IEC 61800-3
  - 5. National Electric Code (NEC)
    - a. NEC 430.120, Adjustable-Speed Drive Systems
  - 6. International Building Code (IBC)
    - a. IBC 2012 Seismic – referencing ASC 7-05 and ICC AC-156
- B. Qualifications:
  - 1. VFDs and options shall be UL508 listed as a complete assembly. The base VFD shall be UL labeled 100 kA RMS Symmetrical, 600V max. C
  - 2. CE Mark – The base VFD shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking.
  - 3. The entire VFD assembly, including the bypass (if scheduled), shall be seismically certified and labeled as such in accordance with the 2012 International Building Code (IBC):
    - a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
  - 4. Acceptable Manufacturers
    - a. ABB ACH Series (basis of design).
    - b. Alternates: Eaton, Yaskawa, Schneider (Square D), Trane. Approval does not relieve the supplier of specification requirements.
    - c. Non-listed alternate manufacturers shall submit a request in writing to the Engineer for approval at least 20 working days prior to bid. Approval does not relieve the supplier of specification requirements.

##### 1.03 SUBMITTALS

- A. Submittals shall include the following information:

**18-01.01 WPMHC Expansion**  
**Childers Architect**  
**2019-12-06**

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**VARIABLE-FREQUENCY**  
**MOTOR CONTROLLERS**

1. Outline dimensions, conduit entry locations, weight and required working clearances.
2. Customer connection and power and control wiring diagrams.
3. Show VFD layout and relationships between other electrical components and adjacent structural and mechanical elements.
4. Complete technical product description includes a complete list of options provided. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.
5. Harmonic Analysis Report: As required, provide the manufacturer's harmonic analysis study and report based upon conditions as described in sections 260573 / 260574. These conditions include but are not limited to the POCC, harmonic limits, normal power / emergency power modes, cable lengths, and transformer / generator data.
6. Operation and maintenance data manuals.

#### **1.04 BUILDING INFORMATION MODELING (BIM)**

- A. BIM objects shall contain IFC parameters and associated data applicable to building system requirements. These elements shall support the analytic process including size, clearance, location, mounting heights, and system information where applicable.
- B. VFD BIM models shall include but are not limited to the following attributes:
  1. Input voltage
  2. Current rating
  3. Model number
  4. Manufacturer
  5. Enclosure type

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. ABB Inc.
  2. Danfoss Inc; Danfoss Drives Div.
  3. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Business Unit.
  4. Schneider Electric.
  5. Siemens Energy & Automation, Inc.
  6. Yaskawa Electric America, Inc.
  7. Honeywell Inc.

#### **2.02 VARIABLE FREQUENCY DRIVES**

- A. The VFD package as specified herein shall be enclosed in a UL Type enclosure completely assembled and tested by the manufacturer in an ISO9001 facility.
- B. The VFD shall provide full rated output from a line of  $\pm 10\%$  of nominal voltage. The VFD shall continue to operate without faulting from a line of  $+30\%$  to  $-35\%$  of nominal voltage.
  1. VFDs shall be capable of continuous full load operation under the following environmental operating conditions:
    - a.  $-15$  to  $40^\circ$  C ( $5$  to  $104^\circ$  F) ambient temperature. Operation to  $50^\circ$  C shall be allowed with a 10% reduction from VFD full load current.
    - b. Altitude 0 to 3300 feet above sea level. Operation to 6600 shall be allowed with a 10% reduction from VFD full load current.
    - c. Humidity less than 95%, non-condensing.
- C. All VFDs shall have the following standard features:
  1. All circuit boards shall be coated to protect against corrosion.
  2. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Hand” and “Auto” modes. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.
  4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. VFD programming shall be held in non-volatile memory and is not dependent on battery power
  5. The VFD’s shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
  6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required, based on the temperature of and run command to the drive. VFD protection shall be based on thermal sensing and not cooling fan operation.
  7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
  8. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
  9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
  10. VFDs through 200 HP shall have internal swinging (non-linear) chokes providing impedance equivalent to 5% to reduce the harmonics to the power line. Swinging choke shall be required resulting in superior partial load harmonic reduction. Linear chokes are not acceptable. 5% impedance may be from dual (positive and negative DC bus) chokes, or 5% swinging AC line chokes. VFD’s with only one DC choke shall add an AC line choke.
  11. The required upstream wiring, protection devices, and source transformers shall be based upon the VFD’s input current rating to comply with the contents of NEC 430.122. Input and output current ratings must be shown on the VFD nameplate.
  12. The VFD shall include a coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase and phase to ground), a capacitor clamp, 1600 PIV Diode Bridge and internal chokes. The MOV’s shall have a minimum 125 joule rating per phase across the diode bridge. VFDs that do not include coordinated AC transient surge protection shall include an external TVSS (Transient Voltage Surge Suppressor).
  13. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.
  14. The VFD shall include multiple “two-zone” PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two-zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals.
  15. If the input reference is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
  16. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.
- D. All VFDs to have the following adjustments:
1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating

- the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
  3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
  4. Two (2) programmable analog inputs shall accept current or voltage signals.
  5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
  6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.
  7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable. Drives that have only two (2) relay outputs must provide an option card that provides additional relay outputs.
  8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety input status shall also be transmitted over the serial communications bus.
  9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
  10. Seven (7) programmable preset speeds.
  11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
  12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
  13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
  14. The VFD shall include password protection against parameter changes.
- E. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:

1. Start-up assistant
  2. Parameter assistants
  3. Maintenance assistant
  4. Troubleshooting assistant
  5. Drive optimizer assistants
- F. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
  2. Motor Speed (RPM, %, or Engineering units)
  3. Motor Current
  4. Motor Torque
  5. Motor Power (kW)
  6. DC Bus Voltage
  7. Output Voltage
- G. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.
- H. Serial Communications
1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.
  2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
    - a. Data Sharing – Read Property – B.
    - b. Data Sharing – Write Property – B.
    - c. Device Management – Dynamic Device Binding (Who-Is; I-Am).
    - d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
    - e. Device Management – Communication Control – B.
  3. Serial communication capabilities shall include, but not be limited to; run-stop controls, speed set adjustment, and lock and unlock the keypad. The drive shall have the capability of allowing the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
  4. Serial communication in bypass (if bypass is scheduled) shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
  5. The VFD / bypass shall allow the BAS to control the drive and bypass digital and analog

outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the BAS system. This allows for remote monitoring of which (of up to 4) safeties are open.

6. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass valve control, chilled water valve / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.
- I. EMI / RFI filters. All VFD's shall include onboard EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level (Category C2) with up to 100 feet of motor cable. Second environment (Category C3, C4) is not acceptable, no Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment (C2).
- J. Integral Disconnecting Means & OCPD: Circuit Breaker-Door interlocked, pad-lockable circuit breaker that will disconnect all input power from the drive and all internally mounted options. Circuit breaker configuration shall be available with or without systems requiring bypass.
- K. Drive Options – As noted on the mechanical schedules / notes, optional features shall be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
  1. Disconnect Switch with Fuses - Door interlocked, padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Drive input fusing is included.
  2. Fieldbus adapters – The following optional fieldbus adapters shall be available as a plug in modules.
    - a. LonWorks
    - b. DeviceNet
    - c. Ethernet IP
      - 1) ControlNet over Ethernet & ModBus TCP
    - d. BACnet IP
    - e. Profibus
- L. Bypass Option – As noted on the mechanical schedules / notes, any bypass shall be furnished and mounted by the drive manufacturer. All VFD with bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
  1. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.
  2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the “Off” position before either enclosure may be accessed.
  3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR)  $\geq$  65,000 Amps and this rating shall be indicated on the UL data label.
  4. The drive and bypass package shall be seismic certified and labeled to the IBC:
    - a. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake table test data as defined by ICC AC-156.
    - b. Special seismic certification of equipment and components shall be provided by OSHPD preapproval.
  5. Drive Isolation Fuses - To ensure maximum availability of bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor “isolation contactors” are not an acceptable alternative to fuses, as contactors could weld closed and are

- not an NEC recognized disconnecting device.
6. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
  7. Motor protection from single phase power conditions - the bypass system must be able to detect a single-phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single-phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
  8. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.
  9. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP.
    - a. Serial communication capabilities shall include, but not be limited to: bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (Amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad “Hand” or “Auto” selected, bypass selected, and broken belt indication. The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.
    - b. The bypass serial communications shall allow control of the drive/bypass (system) digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The system digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. All system analog and digital I/O shall be capable of being monitored by the BAS system.
  10. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the BAS and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause a warning or system shutdown.
  11. The digital inputs for the system shall accept 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.
  12. There shall be a coordinated run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open before the motor can run. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman’s override / smoke control mode.
  13. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition

- shall be indicated on the bypass LCD display, programmed to activate a Form-C relay output, and / or over the serial communications protocol.
14. The bypass control shall include a programmable time delay bypass start including keypad indication of the time delay. A Form C relay output commands the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.
  15. There shall be a keypad adjustment to select manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:
    - a. Over current
    - b. Over voltage
    - c. Under voltage
    - d. Loss of analog input
  16. The following operators shall be provided:
    - a. Bypass Hand-Off-Auto
    - b. Drive mode selector
    - c. Bypass mode selector
    - d. Bypass fault reset
  17. The bypass shall include the ability to select the operating mode of the system (VFD/Bypass) from either the bypass keypad or digital input.
  18. The bypass shall include a two-line, 20-character LCD display. The display shall allow the user to access and view various parameters.
  19. The bypass shall include indicating lights (LED type) or keypad display indications. Also, a test mode or push to test feature shall be provided.
  20. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS system even with the VFD removed.
  21. The on-board Form-C relay outputs in the bypass shall be programmable for various events.
  22. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.
  23. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps.
  24. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.
  25. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.
  26. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the



local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.

27. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.
28. Drive Service Switch – Drive service switches shall be furnished and mounted by the drive manufacturer as defined on the VFD schedule. VFD/Bypass configurations that utilize contactors to remove VFD input power for the purpose of VFD servicing are not acceptable. The NEC Code does not recognize a contactor as a means of disconnect in a motor control circuit.

## **2.03 FILTERS**

- A. Input Line Conditioning: As required per the manufacturer's harmonic analysis study and report, provide input filtering to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE-519 recommendations.
  1. The harmonic filter shall treat all characteristic low frequency harmonics generated by 3-phase full wave converter load (5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup>, 13<sup>th</sup>, etc.).
  2. The harmonic filter shall be an adaptive passive series connected low pass filter consisting of an inductor – capacitor network.
  3. The harmonic filter shall be UL-508 listed and meet the Total Demand Distortion (TDD) and Total Harmonic Voltage Distortion (THVD) requirements of IEEE-519, tables 10-3 / 10-2.
  4. To ensure generator compatibility, the harmonic filter shall never introduce a capacitive reactive power (KVAR) that is > 20% of its KVA rating.
  5. The Total Harmonic Current Distortion (THID) shall be ≤ 5% @ full load and ≤ 8% @ 30% load.
  6. As the basis-of-design product, provide MTE's Matrix passive filter. Subject to compliance with requirements, provide an alternate product such as TCI's HG7.
- B. Output Conditioning: As required to provide common mode and rise time reduction as well as peak voltage reduction caused by IGBT-based drives connected by long leads (< 1000'), provide a dampened low pass filter to reduce motor failures.
  1. The filter shall reduce the peak voltage waveform voltage at the motor windings to 150% of the DC bus voltage up to 1000'.
  2. The filter shall reduce the rise time (dv/dt) at the motor terminals ≤ 0.1 μS.
  3. The filter shall attenuate the common mode current to reduce the stress from bearing currents by a minimum of 30%.
  4. The filter shall be capable of operating @ 150% current for 1 minute, repeated every 10 minutes.
  5. The filter shall be built to comply with UL-508A and be constructed with copper wire.
  6. As the basis-of-design product, provide MTE's dV Sentry filter. Subject to compliance with requirements, provide an alternate product such as TCI's V1k.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine VFDs before installation. Reject any VFDs that are damaged by moisture or dings / dents.
- B. Examine roughing-in for conduits to verify the actual locations and connections.
  1. The line, load and control wiring are to be installed in separate metal conduits.
- C. Examine the mounting requirements for each VFD. Verify that the VFD's workspace clearances comply with the manufacturer's documentation and the NEC 110.26.

### **3.02 INSTALLATION**

- A. The wiring shall be completed by the electrical contractor as per the NEC (430.122) wiring requirements based on the VFD input current. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Identify VFDs as described in Section 26 0553.

### **3.03 START-UP**

- A. Factory start-up shall be provided for each drive by a factory authorized service center. A start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

### **3.04 PRODUCT SUPPORT**

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line connected to factory support personnel located in the US shall be available. Technical support offered only through the local sales office is not acceptable.
- B. Training shall include installation, programming and operation of the VFD, bypass and serial communication. Factory authorized start up and owner training to be provided locally upon request.
- C. Prepare reports of startup adjustments and parameters settings.

### **3.05 WARRANTY**

- A. The VFD Product Warranty shall be 36 months from the date of factory shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

**END OF SECTION**

## SECTION 23 0516

### EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Slip-joint packed expansion joints.
  - 2. Expansion-compensator packless expansion joints.
  - 3. Metal-bellows packless expansion joints.
  - 4. Pipe loops and swing connections.
  - 5. Alignment guides and anchors.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product certificates.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

##### 1.5 QUALITY ASSURANCE

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

2. ASME Boiler and Pressure Vessel Code: Section IX.

## **PART 2 - PRODUCTS**

### **2.1 PACKED EXPANSION JOINTS**

- A. Slip-Joint Packed Expansion Joints:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Adscos Manufacturing LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Hyspan Precision Products, Inc.
  2. Standard: ASTM F 1007.
  3. Material: Carbon steel with asbestos-free PTFE packing.
  4. Design: With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
  5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
  6. End Connections: Flanged or weld ends to match piping system.

### **2.2 PACKLESS EXPANSION JOINTS**

- A. Metal, Expansion-Compensator Packless Expansion Joints:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Adscos Manufacturing LLC.
    - b. Flexicraft Industries.
    - c. Flex Pression Ltd.
    - d. Flex-Weld, Inc.
    - e. Hyspan Precision Products, Inc.
    - f. Metraflex, Inc.
    - g. Senior Flexonics Pathway.
    - h. Unaflex.
    - i. Unisource Manufacturing, Inc.
  2. Minimum Pressure Rating: 150 psig unless otherwise indicated.
  3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.
    - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.
  4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
    - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
    - b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged.

- B. Metal-Bellows Packless Expansion Joints:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. AdSCO Manufacturing LLC.
    - b. American BOA, Inc.
    - c. Badger Industries, Inc.
    - d. Expansion Joint Systems, Inc.
    - e. Flex-Hose Co., Inc.
    - f. Flexicraft Industries.
    - g. Flex Pression Ltd.
    - h. Flex-Weld, Inc.
    - i. Flo Fab inc.
    - j. Hyspan Precision Products, Inc.
    - k. Metraflex, Inc.
    - l. Proco Products, Inc.
    - m. Senior Flexonics Pathway.
    - n. Tozen Corporation.
    - o. Unaflex.
    - p. Unisource Manufacturing, Inc.
    - q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
    - r. U.S. Bellows, Inc.
    - s. WahlcoMetroflex.
  2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
  3. Type: Circular, corrugated bellows with external tie rods.
  4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
  5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
  6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
    - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
  7. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
    - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
    - b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged.

## 2.3 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A 36/A 36M.

2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

## **PART 3 - EXECUTION**

### **3.1 EXPANSION-JOINT INSTALLATION**

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install packed-type expansion joints with packing suitable for fluid service.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

### **3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION**

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

### **3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION**

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to

expansion joint not more than four pipe diameters from expansion joint.

- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

**END OF SECTION**

## SECTION 23 0517

### SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

##### 2.2 SLEEVE-SEAL SYSTEMS

- 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. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
  - 4. Pipeline Seal and Insulator, Inc.
  - 5. Proco Products, Inc.



- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: NBR 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.

### **2.3 GROUT**

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION**

- 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, 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. Comply with requirements for sealants specified in Section 07 9200 "Joint Sealants."

- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 8413 "Penetration Firestopping."

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- 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.

### **3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE**

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
      - 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. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
  - 4. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

**END OF SECTION**

## SECTION 23 0518

### ESCUTCHEONS FOR HVAC 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. Escutcheons.
  - 2. Floor plates.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

##### 2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- 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.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
  - 2. Escutcheons for Existing Piping:
    - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated finish.
    - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
    - i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated finish.
    - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
- 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: One-piece, floor-plate type.
  - 2. Existing Piping: Split-casting, floor-plate type.

**3.2 FIELD QUALITY CONTROL**

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

## SECTION 23 0523

### GENERAL-DUTY VALVES FOR HVAC PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Bronze ball valves.
  - 2. Iron, single-flange butterfly valves.
  - 3. Bronze swing check valves.
  - 4. Iron swing check valves.
  - 5. Bronze gate valves.
  - 6. Iron gate valves.
  - 7. Bronze globe valves.
  - 8. Iron globe valves.
  - 9. Chainwheels.
  
- B. Related Sections:
  - 1. Section 23 0553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

##### 1.3 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
  
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
  
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
  
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
  
- D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

## 2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

## 2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.

- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 150 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

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

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

## 2.4 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

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

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.



2. Description:
  - a. Standard: MSS SP-80, Type 4.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: PTFE or TFE.

## 2.5 IRON SWING CHECK VALVES

### A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
  - d. Body Design: Clear or full waterway.
  - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - f. Ends: Flanged.
  - g. Trim: Bronze.
  - h. Gasket: Asbestos free.

## 2.6 BRONZE GATE VALVES

### A. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Hammond Valve.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.
  - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.

- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.7 IRON GATE VALVES

### A. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Disc: Solid wedge.
  - h. Packing and Gasket: Asbestos free.

### B. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Stockham Division.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Powell Valves.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-70, Type I.
  - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
  - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Disc: Solid wedge.
  - h. Packing and Gasket: Asbestos free.

## 2.8 BRONZE GLOBE VALVES

### A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
  - d. Ends: Threaded.
  - e. Stem: Bronze.
  - f. Disc: PTFE or TFE.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, bronze, or aluminum.

## 2.9 IRON GLOBE VALVES

### A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. Crane Co.; Crane Valve Group; Stockham Division.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  
2. Description:
  - a. Standard: MSS SP-85, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - d. Ends: Flanged.
  - e. Trim: Bronze.
  - f. Packing and Gasket: Asbestos free.

## 2.10 CHAINWHEELS

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

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to butterfly valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## **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 chainwheels on operators for butterfly gate and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

### **3.3 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball or butterfly valves.
  2. Throttling Service, Except Steam: Globe valves.
  3. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
    - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
  4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  6. For Steel Piping, NPS 5 and Larger: Flanged ends.

### 3.5 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Ball Valves: Two piece, full port, bronze with bronze trim.
  3. Bronze Swing Check Valves: Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
  2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
  3. Iron Swing Check Valves: Class 125, metal seats.
  4. Iron Gate Valves: Class 125, OS&Y.
  5. Iron Globe Valves: Class 125.

### 3.6 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Ball Valves: Two piece, full port, bronze with bronze trim.
  3. Bronze Swing Check Valves: Class 150, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24: 150 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125, OS&Y.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

**END OF SECTION**

## SECTION 23 0529

### HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fastener systems.
  - 4. Equipment supports.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. 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.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

##### 1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

#### PART 2 - PRODUCTS

##### 2.1 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 or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 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. Copper Pipe 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.

## **2.2 TRAPEZE PIPE HANGERS**

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## **2.3 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, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## **2.4 EQUIPMENT SUPPORTS**

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## **2.5 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, 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 HANGER AND SUPPORT INSTALLATION**

- 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 Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. 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.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- F. Install hangers and supports to allow controlled thermal 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.
- 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 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.
- J. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-

distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.2 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.

### **3.3 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded 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.

### **3.4 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.5 PAINTING**

- A. Touchup: 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 A 780.

### **3.6 HANGER AND SUPPORT SCHEDULE**

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 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 metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.

4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

6. 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.

7. 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.

8. 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.

9. 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 not necessary.

- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. 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.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

- 3. 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.
  
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
  
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**END OF SECTION**

## SECTION 23 0553

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Valve tags.

##### 1.2 ACTION SUBMITTAL

- 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 to include in maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
  - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the

Specification Section number and title where equipment is specified.

- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## **2.2 WARNING SIGNS AND 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 Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## **2.3 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## **2.4 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
  - 1. Tag Material: Brass, 0.032-inch (0.8-mm) Stainless steel, 0.025-inch (0.64-mm) Aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) 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. Valve-tag schedule shall be included in operation and maintenance data.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.3 PIPE LABEL INSTALLATION**

- A. 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. Near 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. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.



### **3.4 VALVE-TAG INSTALLATION**

- 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

**END OF SECTION**

## SECTION 23 0593

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Constant-flow hydronic systems.
    - b. Variable-flow hydronic systems.

##### 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

##### 1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage an Independent TAB entity certified by AABC, NEBB, or TABB.
- B. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.7.2.3 - "System Balancing."

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 23 3113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible

and their controls are connected and functioning.

- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.2 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
  - 1. Comply with requirements in ASHRAE 62.1-2007, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 23 0713 "Duct Insulation," Section 23 0716 "HVAC Equipment Insulation," Section 23 0719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other

suitable, permanent identification material to show final settings.

- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 23 3113 "Metal Ducts."

### **3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  8. Measure the return airflow to the fan while operating at maximum return airflow and

minimum outdoor airflow.

- a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.
  4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Adjust terminal units for minimum airflow.
  6. Measure static pressure at the sensor.
  7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

### **3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### **3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS**

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow



and verify that the pump has the intended impeller size.

- a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Section 23 2123 "Hydronic Pumps."
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
  1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
  1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

### **3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS**

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### **3.10 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
  
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### **3.11 PROCEDURES FOR CONDENSING UNITS**

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### **3.12 PROCEDURES FOR CHILLERS AND BOILERS**

- A. Measure and record entering- and leaving-water temperatures and water flow.

### **3.13 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Measure, adjust, and record the following data for each water coil:
  - 1. Entering- and leaving-water temperature.
  - 2. Water flow rate.
  - 3. Water pressure drop.
  - 4. Dry-bulb temperature of entering and leaving air.
  - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
  - 6. Airflow.
  - 7. Air pressure drop.
  
- B. Measure, adjust, and record the following data for each electric heating coil:
  - 1. Nameplate data.
  - 2. Airflow.
  - 3. Entering- and leaving-air temperature at full load.
  - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
  - 5. Calculated kilowatt at full load.
  - 6. Fuse or circuit-breaker rating for overload protection.
  
- C. Measure, adjust, and record the following data for each steam coil:
  - 1. Dry-bulb temperature of entering and leaving air.
  - 2. Airflow.
  - 3. Air pressure drop.

4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

### **3.14 TOLERANCES**

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets:
  - a. General Rooms: Plus or minus 10 percent.
  - b. Negative Rooms: Laboratories, Chemical Storage, Bio Hazard, Soiled Rooms, Isolation Rooms, Decontamination, Anesthesia Workroom, Medical and Dental Gas Storage:
    - 1) Outlets: Plus 0 percent, minus 10 percent.
    - 2) Inlets: Plus 10 percent, minus 0 percent.
  - c. Positive Rooms: Clean Workrooms, Clean Utility, Dispensing Workroom, IV Workroom, Sterile Supply and Storage, Procedure Rooms, Dental Workroom Sterile:
    - 1) Outlets: Plus 10 percent, minus 0 percent.
    - 2) Inlets: Plus 0 percent, minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

### **3.15 REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### **3.16 FINAL REPORT**

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

### 3.17 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are

being maintained throughout and to correct unusual conditions.

- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION**

**SECTION 23 0713**  
**DUCT INSULATION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, concealed supply and return.
  - 8. Outdoor, exposed supply and return.
  
- B. Related Sections:
  - 1. Section 23 0719 "HVAC Piping Insulation."
  - 2. Section 23 3113 "Metal Ducts" for duct liners.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  
- 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.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.4 QUALITY ASSURANCE**

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, 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.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## **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 II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Owens Corning; SOFTR All-Service Duct Wrap.
- 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 without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Insulation Board.
    - d. Owens Corning; Fiberglas 700 Series.

## 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.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).



- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## 2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - d. Mon-Eco Industries, Inc.; 44-05.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

## 2.5 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
  5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.

3. Color: Color-code jackets based on system. Color as selected by Architect].
- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Sheet and roll stock ready for shop or field sizing.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### **3.2 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 4 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.

### **3.3 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
  - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

### 3.4 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 50 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, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops 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.

### **3.5 FIELD-APPLIED JACKET INSTALLATION**

- A. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. 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.

### **3.6 FINISHES**

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "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. Perform tests and inspections.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.



### **3.8 DUCT INSULATION SCHEDULE, GENERAL**

- A. Refer to schedules on drawings for material and thickness application to duct systems.
- B. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, concealed supply and return.
  - 8. Outdoor, exposed supply and return.
- C. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1-2007.
  - 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.

**END OF SECTION**

## SECTION 23 0716

### HVAC EQUIPMENT INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes insulating the following HVAC equipment that is not factory insulated:
  - 1. Chilled-water pumps.
  - 2. Heating, hot-water pumps.
  - 3. Expansion/compression tanks.
  - 4. Air separators.
  
- B. Related Sections:
  - 1. Section 23 0713 "Duct Insulation."
  - 2. Section 23 0719 "HVAC Piping Insulation."

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail removable insulation at equipment connections.
  - 4. Detail application of field-applied jackets.
  - 5. Detail application at linkages of control devices.
  - 6. Detail field application for each equipment type.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, 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.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pittsburgh Corning Corporation; Foamglas.
    - 2. Block Insulation: ASTM C 552, Type I.
    - 3. Special-Shaped Insulation: ASTM C 552, Type III.
    - 4. Board Insulation: ASTM C 552, Type IV.
    - 5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Sheet and K-FLEX LS.
- G. 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 I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x

deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. CertainTeed Corp.; CrimpWrap.
  - b. Johns Manville; MicroFlex.
  - c. Knauf Insulation; Pipe and Tank Insulation.
  - d. Manson Insulation Inc.; AK Flex.
  - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
  - f. .

## 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aeroseal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

- b. Eagle Bridges - Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
- d. Mon-Eco Industries, Inc.; 22-25.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Corning Corporation; 739, Dow Silicone.
- b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Speedline Corporation; Polyco VP Adhesive.

## 2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.
- b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
- b. Eagle Bridges - Marathon Industries; 550.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
- d. Mon-Eco Industries, Inc.; 55-50.
- e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: 60 percent by volume and 66 percent by weight.

5. Color: White.

## 2.4 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

### B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

### C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

## 2.5 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated tank heads and tank side panels.
- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Finish and thickness are indicated in field-applied jacket schedules.
  3. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
  4. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  5. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.
    - e. End caps.
    - f. Beveled collars.
    - g. Valve covers.
    - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. **<Insert manufacturer's name; product name or designation>.**
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.



2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ABI, Ideal Tape Division; 488 AWF.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
  - c. Compac Corporation; 120.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.8 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Insulation Pins and Hangers:

1. 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.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

## 2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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.
  - 4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- 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.
- 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.
- O. 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. Manholes.
5. Handholes.
6. Cleanouts.

### **3.3 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION**

- A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. 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.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.4 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.5 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "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.

### **3.6 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections: Inspect field-insulated equipment, 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 type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.7 EQUIPMENT INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment that is not factory insulated.
- C. Chilled-water pump insulation shall be one of the following:
  - 1. Cellular Glass: 3 inches thick.
  - 2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- D. Heating-Hot-Water Pump Insulation: Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- E. Chilled-water expansion/compression tank insulation shall be one of the following:
  - 1. Cellular Glass: 1-1/2 inches thick.
  - 2. Flexible Elastomeric: 1 inch thick.
  - 3. Mineral-Fiber Pipe and Tank: 1 inch thick.
- F. Heating-Hot-Water Expansion/Compression Tank Insulation: Mineral-Fiber Pipe and Tank: 1 inch thick.
- G. Chilled-water air-separator insulation shall be one of the following:
  - 1. Cellular Glass: 2 inches thick.
  - 2. Flexible Elastomeric: 1 inch thick.
  - 3. Mineral-Fiber Pipe and Tank: 1 inch thick.
- H. Heating-Hot-Water Air-Separator Insulation: Mineral-Fiber Pipe and Tank: 2 inches thick.

### **3.8 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:

1. None.
- D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
1. PVC: 20 mils thick.

**END OF SECTION**

## SECTION 23 0719

### HVAC 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 HVAC piping systems:
  - 1. Condensate drain piping, indoors.
  - 2. Chilled-water and brine piping, indoors and outdoors.
  - 3. Heating hot-water piping, indoors.
  - 4. Steam and steam condensate piping, indoors.
  - 5. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Sections:
  - 1. Section 23 0713 "Duct Insulation."
  - 2. Section 23 0716 "HVAC Equipment Insulation."
  - 3. Section 23 2113.13 "Underground Hydronic Piping" for loose-fill pipe insulation in underground piping outside the building.

##### 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 attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.



- B. Field quality-control reports.

## **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting 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.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## **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 23 0529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## **1.8 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. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Calcium Silicate:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
  - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. FibreX Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
    - b. Eagle Bridges - Marathon Industries; 290.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
    - d. Mon-Eco Industries, Inc.; 22-30.
    - e. Vimasco Corporation; 760.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Dow Corning Corporation; 739, Dow Silicone.
  - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
  - b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. Eagle Bridges - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.4 SEALANTS

### A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 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. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: White.
  - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  - 2. Aluminum Jacket: Comply with ASTM B 209, 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 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-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.
- E. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pittsburgh Corning Corporation; Pittwrap.
    - b. Polyguard Products, Inc.; Insulrap No Torch 125.

## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. 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.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.8 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with.

### B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

### C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. C & F Wire.

## 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.
  3. 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.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.



### 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 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 application and finishing.
- 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 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.
  - 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, 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 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 similar 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. Manholes.
    5. Handholes.
    6. Cleanouts.

### **3.4 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

### **3.5 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, 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 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 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 used for adjacent pipe. Overlap adjoining pipe insulation by not less than two 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 two 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 and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.6 INSTALLATION OF CALCIUM SILICATE INSULATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
  2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
  3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- 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 cut sections of block insulation of same material and thickness as pipe insulation.
  4. Finish flange insulation same as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

### 3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 INSTALLATION OF 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 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 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.

### **3.9 FIELD-APPLIED JACKET INSTALLATION**

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. 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 FINISHES**

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "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.

### **3.11 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.12 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.

### **3.13 PIPING INSULATION SCHEDULE**

- A. Refer to drawings for schedule.

**END OF SECTION**



**SECTION 23 2113**  
**HYDRONIC 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 pipe and fitting materials and joining methods for the following:
  - 1. Hot-water heating piping.
  - 2. Chilled-water piping.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Other building services.
  - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

**1.4 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  1. Hot-Water Heating Piping: 150 psig at 200 deg F.
  2. Chilled-Water Piping: 150 psig at 200 deg F.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Grooved Mechanical-Joint Fittings and Couplings:
  1. Joint Fittings: ASME B16.22 wrought copper or ASME B16.18 cast bronze with copper-tube dimensioned grooved ends to accept grooved-end couplings.
  2. Couplings: Ductile-iron housings cast with offsetting, angle-pattern, bolt pads, EPDM-HP gasket of central cavity pressure-responsive design; with ASTM A449 compliant bolts and nuts to secure copper-tube dimensioned grooved pipe and fittings. Installation-ready for direct stab installation without field disassembly.

### **2.3 STEEL PIPE AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  1. Material Group: 1.1.
  2. End Connections: Butt welding.

3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
1. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B factory-fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with ASTM A449 compliant nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
  2. Couplings: Two ductile-iron housings and EPDM or nitrile gasket of central cavity pressure-responsive design; with ASTM A449 compliant bolts, nuts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Couplings shall comply with ASTM F-1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
    - a. Rigid: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Installation-Ready, for direct stab installation without field disassembly.
    - b. Flexible: Use in locations where vibration attenuation and stress relief are required.
    - c. Two-segment couplings for NPS 14" and larger piping with lead-in chamfer on housing key and wide-width FlushSeal gasket.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

## 2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
    - a. Full-Face Type: For flat-face, 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.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Grooved Joint Lubricants: Lubricate gaskets with lubricant supplied by the coupling manufacturer in accordance with published installation instructions. The lubricant shall approved for the gasket elastomer and system media.
- F. 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.
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. A.Y. McDonald Mfg. Co.
    - b. Capitol Manufacturing Company.
    - c. Central Plastics Company.
    - d. Hart Industries International, Inc.
    - e. Jomar International Ltd.
    - f. Matco-Norca.
    - g. Watts Regulator Co.
    - h. Zurn Industries, LLC.
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Pressure Rating: 150 psig.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Matco-Norca.
    - d. Watts Regulator Co.
    - e. Zurn Industries, LLC.
  2. Description:
    - a. Standard: ASSE 1079.
    - b. Factory-fabricated, bolted, companion-flange assembly.
    - c. Pressure Rating: 150 psig.
    - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, 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.
- E. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low-lead requirements of NSF-372.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS**

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
  1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  2. Type L; hard-drawn copper tubing, wrought-copper or cast-bronze, grooved-joint fittings; and copper-tube dimensioned grooved joints.
  3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
  4. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
  1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  2. Type L; hard-drawn copper tubing, wrought-copper or cast-bronze, grooved-joint fittings; and copper-tube dimensioned grooved joints.
  3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

- 4. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- G. Air-Vent Piping:
  - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
  - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

### **3.2 PIPING INSTALLATIONS**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless 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. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 23 0523 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points if required.)
- T. Install shutoff valve immediately upstream of each dielectric fitting.
- U. Comply with requirements in Section 23 0516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.
- V. Comply with requirements in Section 23 0553 "Identification for HVAC Piping and Equipment" for identifying piping.
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### **3.3 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions or waterway fittings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or waterway fittings.

### **3.4 HANGERS AND SUPPORTS**

- A. Comply with requirements in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.
- C. Install the following pipe attachments:
  1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  4. Spring hangers to support vertical runs.
  5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet.
  2. NPS 1: Maximum span, 7 feet.
  3. NPS 1-1/2: Maximum span, 9 feet.
  4. NPS 2: Maximum span, 10 feet.
  5. NPS 2-1/2: Maximum span, 11 feet.
  6. NPS 3 and Larger: Maximum span, 12 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. 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.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### **3.5 PIPE JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.



- G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Use grooved-end fittings and rigid, grooved-end-pipe couplings. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.
- H. Optional: At owner's option the installing contractor shall use a quality program such as an inspection service to ensure proper installation of grooved components and upon completion of the manufacturer's inspection of the installation, they shall supply the owner a report and warranty.

### **3.6 TERMINAL EQUIPMENT CONNECTIONS**

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 23 0519 "Meters and Gages for HVAC Piping."

### **3.7 CHEMICAL TREATMENT**

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

### **3.8 FIELD QUALITY CONTROL**

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  3. Isolate expansion tanks and determine that hydronic system is full of water.
  4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
  2. Inspect pumps for proper rotation.
  3. Set makeup pressure-reducing valves for required system pressure.
  4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  5. Set temperature controls so all coils are calling for full flow.
  6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  7. Verify lubrication of motors and bearings.

**END OF SECTION**

## SECTION 23 2116

### HYDRONIC 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 special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Condenser-water piping.
4. Glycol cooling-water piping.
5. Makeup-water piping.
6. Condensate-drain piping.
7. Blowdown-drain piping.
8. Air-vent piping.
9. Safety-valve-inlet and -outlet piping.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

##### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

## 1.6 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  - 1. Hot-Water Heating Piping: 150 psig at 200 deg F.
  - 2. Chilled-Water Piping: 150 psig at 200 deg F.
  - 3. Condenser-Water Piping: 150 psig at 200 deg F.
  - 4. Glycol Cooling-Water Piping: 150 psig at 200 deg F.
  - 5. Makeup-Water Piping: 80 psig at 150 deg F.
  - 6. Condensate-Drain Piping: 150 deg F.
  - 7. Blowdown-Drain Piping: 200 deg F.
  - 8. Air-Vent Piping: 200 deg F.
  - 9. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

### 2.2 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 23 0523 "General-Duty Valves for HVAC Piping."Section 15112 "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 23 0900 "Instrumentation and Control for HVAC."Section 15900 "HVAC Instrumentation and Controls."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Domestic Pump.
    - c. Flow Design Inc.
    - d. Gerand Engineering Co.
    - e. Griswold Controls.
    - f. Nexus Valve, Inc.
    - g. Taco.
    - h. Victaulic Company
  - 2. Body: DZR Brass (Ametal®) globe type or bronze, ball or plug type with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.
4. Disc: DZR Brass (Ametal®).
5. Plug: Resin.
6. Seat: PTFE or EPDM.
7. End Connections: Threaded or socket.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Multiple-turn handwheel for precise balancing or standard lever, with memory stop to retain set position.
10. CWP Rating: Minimum 250 psig (1725 kPa).
11. Maximum Operating Temperature: 230 deg F (110 deg C).
12. Koil-Kits may be used at coil connections. The kit shall include a circuit balancing valve, Y Strainer-Ball or Union-Ball valve combination, Union-Port fitting, and required coil hoses. A Differential pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building owner after commissioning.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Armstrong Pumps, Inc.
  - b. Bell & Gossett Domestic Pump.
  - c. Flow Design Inc.
  - d. Gerand Engineering Co.
  - e. Griswold Controls.
  - f. Taco.
  - g. Victaulic Company
2. Body: Cast ductile-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: DZR Brass (Ametal®) or glass and carbon-filled PTFE.
6. Seat: PTFE or EPDM.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 250 psig (1725 kPa).
11. Maximum Operating Temperature: 230 deg F (110 deg C).

E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Conbraco Industries, Inc.
  - e. Spence Engineering Company, Inc.
  - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.

7. Low inlet-pressure check valve.
8. Inlet Strainer: , removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves: ASME labeled.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Conbraco Industries, Inc.
  - e. Spence Engineering Company, Inc.
  - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: , removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Flow Design Inc.
  - b. Griswold Controls.
  - c. Nexus Valve, Inc.
  - d. Victaulic Company
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

## 2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Nexus Valve, Inc.
  - e. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/8 (DN 6).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Nexus Valve, Inc.
  - e. Taco, Inc.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2 (DN 15).
6. Discharge Connection: NPS 1/4 (DN 8).
7. CWP Rating: 150 psig (1035 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

C. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
  - e. Wessels
  - f. Elbi.
2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
  - e. Elbi.
2. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

E. Air Purgers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
3. Maximum Working Pressure: 150 psig (1035 kPa).
4. Maximum Operating Temperature: 250 deg F (121 deg C).

## 2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body:
  - a. ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  - b. ASTM A 536, Grade 65-45-12, ductile iron with coupled cover.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged or grooved ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 300 psig (2065 kPa).

B. Basket Strainers:

1. Body:
  - a. ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
  - b. ASTM A 536, Grade 65-45-12, ductile iron with coupled cover.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged or grooved ends for NPS 2-1/2 (DN 65) and larger.



3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 300 psig (2065 kPa).

C. Suction Diffuser:

Flanged outlet with grooved inlet connections, rated to 300 psi. Ductile iron (ASTM A-536) body, 304 stainless steel frame and perforated sheet diffuser with 5/32" diameter holes. Removable 20 mesh 304 stainless steel start-up pre-filter, outlets for pressure/temperature drain connections, and base support boss.

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Three flexible type grooved joint couplings may be used in lieu of flexible connectors at equipment connections in applicable piping systems. The couplings shall be placed in close proximity to the vibration source.

G. Expansion Fittings: Comply with requirements in Section 23 0516 "Expansion Fittings and Loops for HVAC Piping." Section 15124 "Expansion Fittings and Loops for HVAC Piping."

H. Factory-Assembled Pump Drops: Factory assembled grooved end drop for pipe sizes 3" through 12" (DN80 through DN300). Orange enamel coated assembly, consisting of a Class 150 flange for pump connection, required elbow and reducers, valves, specialties, and pipe spool with thermometer and pressure ports. (Butterfly valves used in assemblies shall have a pressure responsive seat and stem offset from the disc centerline to provide complete 360-degree circumferential seating. Assembly is installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief. Assembly rated for working pressure to 300-psig (2068-kPa).

1. Grooved end vibration pump discharge drop with tri-service valve assembly consisting of a spring-actuated check [Venturi-Check] valve and butterfly valve.
2. Grooved end vibration pump suction drop consisting of a suction diffuser with stainless steel basket and diffuser and Class 150 flange for pump connection, and butterfly valve.
3. Grooved end vibration pump suction drop consisting of a 90-degree base elbow, Wye pattern strainer with stainless steel perforated metal basket, and butterfly valve.

## **PART 3 - EXECUTION**

### **3.1 VALVE APPLICATIONS**

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

### **3.2 HYDRONIC SPECIALTIES INSTALLATION**

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

**END OF SECTION**

## SECTION 23 2123

### HYDRONIC PUMPS

#### 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. Close-coupled, in-line centrifugal pumps.
  - 2. Separately coupled, horizontally mounted, in-line centrifugal pumps.
  - 3. Separately coupled, vertically mounted, in-line centrifugal pumps.
  - 4. Separately coupled, base-mounted, end-suction centrifugal pumps.

##### 1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
  - 1. Show pump layout and connections.
  - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
  - 3. Include diagrams for power, signal, and control wiring.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

## 1.6 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. Mechanical Seals: One mechanical seal(s) for each pump.

## PART 2 - PRODUCTS

### 2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong Pumps Inc.
  2. Aurora Pump; Division of Pentair Pump Group.
  3. Grundfos Pumps Corporation.
  4. ITT Corporation; Bell & Gossett.
  5. PACO Pumps.
  6. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
  7. TACO Incorporated.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet and threaded companion-flange connections.
  2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
  3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
  4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
  5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
  6. Pump Bearings: Permanently lubricated ball bearings.
- D. Motor: Single speed and rigidly mounted to pump casing.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."

## 2.2 SEPARATELY COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong Pumps Inc.
  2. Aurora Pump; Division of Pentair Pump Group.
  3. Grundfos Pumps Corporation.
  4. ITT Corporation; Bell & Gossett.
  5. PACO Pumps.
  6. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
  7. TACO Incorporated.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
  2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
  3. Pump Shaft: Stainless steel.
  4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
  5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
  6. Pump Bearings: Oil lubricated; bronze-journal or thrust type.
- D. Shaft Coupling: Axially split spacer coupling.
- E. Motor: Single speed and rigidly mounted to pump casing with lifting eyebolt and supporting lugs in motor enclosure.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."

## 2.3 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Armstrong Pumps Inc.
  2. Aurora Pump; Division of Pentair Pump Group.
  3. Grundfos Pumps Corporation.
  4. ITT Corporation; Bell & Gossett.
  5. PACO Pumps.

6. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.
  7. TACO Incorporated.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
  2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.
  3. Pump Shaft: Stainless steel.
  4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket.
  5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
  6. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
- D. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. EPDM coupling sleeve for variable-speed applications.
- E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- G. Motor: Single speed, secured to mounting frame, with adjustable alignment.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."

## 2.4 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
1. Angle pattern.
  2. 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
  3. Bronze startup and bronze or stainless-steel permanent strainers.
  4. Bronze or stainless-steel straightening vanes.
  5. Drain plug.

6. Factory-fabricated support.
- B. Triple-Duty Valve:
1. Angle or straight pattern.
  2. 175-psig pressure rating, cast-iron body, pump-discharge fitting.
  3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
  4. Brass gage ports with integral check valve and orifice for flow measurement.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PUMP INSTALLATION**

- A. Comply with HI 1.4.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 03 3000 "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
  1. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
  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.
  6. Install on 4-inch- high concrete base.
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
2. Comply with requirements for hangers and supports specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment."

### **3.3 ALIGNMENT**

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

### **3.4 CONNECTIONS**

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install check, shutoff, and throttling valves or triple-duty valve on discharge side of pumps.
- E. Install suction diffuser and shutoff valve on suction side of pumps.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- I. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Check piping connections for tightness.
  3. Clean strainers on suction piping.



4. Perform the following startup checks for each pump before starting:
  - a. Verify bearing lubrication.
  - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
  - c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

### **3.6 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

**END OF SECTION**

**SECTION 23 2300**  
**REFRIGERANT PIPING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-134a:
  - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
  - 2. Suction Lines for Heat-Pump Applications: 225 psig.
  - 3. Hot-Gas and Liquid Lines: 225 psig.
- B. Line Test Pressure for Refrigerant R-407C:
  - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
  - 2. Suction Lines for Heat-Pump Applications: 380 psig.
  - 3. Hot-Gas and Liquid Lines: 380 psig.
- C. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
  - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control test reports.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

## **1.6 QUALITY ASSURANCE**

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

## **1.7 PRODUCT STORAGE AND HANDLING**

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

## **PART 2 - PRODUCTS**

### **2.1 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS**

- A. Hot-Gas and Liquid Lines, and Suction Lines: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

### **3.2 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 3113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Section 23 0553 "Identification for HVAC Piping and Equipment."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 0517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 0518 "Escutcheons for HVAC Piping."

### **3.3 PIPE JOINT CONSTRUCTION**

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

### **3.4 HANGERS AND SUPPORTS**

- A. Hanger, support, and anchor products are specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
  - a. Fill system with nitrogen to the required test pressure.
  - b. System shall maintain test pressure at the manifold gage throughout duration of test.
  - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
  - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

### **3.6 SYSTEM CHARGING**

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### **3.7 ADJUSTING**

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION**

## SECTION 23 3113

### METAL DUCTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 3300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main 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: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  - 2. Suspended ceiling components.
  - 3. Structural members to which duct will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Penetrations of smoke barriers and fire-rated construction.
  - 6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- B. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.1 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.
- B. Transverse Joints: Select joint types and fabricate according to 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."
- C. Longitudinal Seams: Select seam types and fabricate according to 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."



- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 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."

## 2.2 ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to 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 according to 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 according to 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."

## 2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- 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. Lindab Inc.
  2. McGill AirFlow LLC.
  3. SEMCO Incorporated.
  4. Sheet Metal Connectors, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
  3. Tees and Laterals: Select types and fabricate according to 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."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- E. 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.

## 2.4 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: G60.
  - 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 the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "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.

## 2.5 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; Insulation Group.
    - b. Johns Manville.
    - 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.
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. 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, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- 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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
    - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
  9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
  10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## **2.6 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 according to UL 723; certified by an NRTL.
- B. 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.
- C. 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.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 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.

## 2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated 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: Cadmium-plated 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 3300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. In congested areas (with respect to other building components / services), coordinate the installed duct connection to its air device so as to provide the designed air flow without any restrictions.

### **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 the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT**

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

### **3.4 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### **3.5 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.

### **3.6 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 23 3300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.7 START UP**

- A. Air Balance: Comply with requirements in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."

### **3.8 DUCT CLEANING**

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 3300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems



### 3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.
- B. Supply Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  - 2. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  - 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 6-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
  - 4. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 4-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A .
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 4-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.

- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1-2007, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
    - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
    - b. Concealed: Carbon-steel sheet.
    - c. Welded seams and joints.
    - d. Pressure Class: Positive or negative 4-inch wg.
    - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - f. SMACNA Leakage Class: 3.
  4. Ducts Connected to Dishwasher Hoods:
    - a. Type 304, stainless-steel sheet.
    - b. Exposed to View: No. 4 finish.
    - c. Concealed: No. 2D finish.
    - d. Welded seams and flanged joints with watertight EPDM gaskets.
    - e. Pressure Class: Positive or negative 3-inch wg.
    - f. Minimum SMACNA Seal Class: Welded
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.

d. SMACNA Leakage Class for Round and Flat Oval: 3.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:
  - a. Exposed to Airstream: Match duct material.
  - b. Not Exposed to Airstream: Galvanized.
3. Aluminum Ducts: Aluminum.

G. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick, only where noted otherwise on drawings.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick, only where noted otherwise on drawings.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
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) 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: Welded.

I. 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: Spin in.
2. Round: 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.

### **3.10 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

**END OF SECTION**

**SECTION 23 3300**  
**AIR DUCT ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Control dampers.
  - 4. Fire dampers.
  - 5. Smoke dampers.
  - 6. Flange connectors.
  - 7. Turning vanes.
  - 8. Duct-mounted access doors.
  - 9. Flexible connectors.
  - 10. Flexible ducts.
  - 11. Duct accessory hardware.
  
- B. Related Requirements:
  - 1. Section 28 3111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

**1.2 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 and smoke-damper installations, including sleeves; and duct-mounted access doors.
    - e. Wiring Diagrams: For power, signal, and control wiring.

**1.3 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

**PART 2 - PRODUCTS**

**2.1 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

- 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 MATERIALS**

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, 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.

## **2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
  - 4. Vent Products Company, Inc.
  - 5. United Enertech
  - 6. Dace
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Felt.
- I. Blade Axles:
  - 1. Material: Nonferrous metal.
  - 2. Diameter: 0.20 inch.

- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Screen Mounting: Rear mounted.
  - 4. Screen Material: Galvanized steel.
  - 5. Screen Type: Insect.
  - 6. 90-degree stops.

## 2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Greenheck Fan Corporation.
    - b. McGill AirFlow LLC.
    - c. Nailor Industries Inc.
    - d. Ruskin Company.
    - e. Vent Products Company, Inc.
    - f. United Enertech
    - g. Dace
    - h. Carnes
  - 2. Standard leakage rating, with linkage outside airstream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Frame: Hat-shaped, 0.094-inch- 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, 0.064 inch thick.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 8. Tie Bars and Brackets: Galvanized steel.
- 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.

## **2.5 CONTROL DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arrow United Industries; a division of Mestek, Inc.
  2. Carnes.
  3. Greenheck Fan Corporation.
  4. McGill AirFlow LLC.
  5. Metal Form Manufacturing, Inc.
  6. Nailor Industries Inc.
  7. Ruskin Company.
  8. Vent Products Company, Inc.
  9. Young Regulator Company.
- B. Frames:
1. Hat shaped.
  2. 0.094-inch- thick, galvanized sheet steel.
  3. Mitered and welded corners.
- C. Blades:
1. Multiple blade with maximum blade width of 8 inches.
  2. Parallel- and opposed-blade design.
  3. Galvanized-steel.
  4. 0.064 inch thick single skin.
  5. Blade Edging: Closed-cell neoprene.
- D. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- E. Bearings:
1. Oil-impregnated bronze, molded synthetic or stainless-steel sleeve.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  3. Thrust bearings at each end of every blade.

## **2.6 FIRE DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arrow United Industries; a division of Mestek, Inc.
  2. Carnes.
  3. Greenheck Fan Corporation.
  4. Nailor Industries Inc.
  5. Prefco; Perfect Air Control, Inc.
  6. Ruskin Company.
  7. Vent Products Company, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.



- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.05 thick, as indicated, and of length to suit application.
  - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## **2.7 SMOKE DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. Carnes.
  - 3. Greenheck Fan Corporation.
  - 4. Nailor Industries Inc.
  - 5. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Provided by fire alarm contractor.
- D. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded or corners and mounting flange.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.05-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- I. Damper Motors: Modulating or two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 23 0900 "Instrumentation and Control for HVAC."
  3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
  5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
- K. Accessories:
1. Auxiliary switches for signaling fan control or position indication.
  2. Test and reset switches, damper mounted.

## **2.8 FLANGE CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Nexus PDQ; Division of Shilco Holdings Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## **2.9 TURNING VANES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. METALAIRE, Inc.
  4. SEMCO Incorporated.
  5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches and double wall for larger dimensions.

## 2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
  2. Cesco Products; a division of Mestek, Inc.
  3. Ductmate Industries, Inc.
  4. Flexmaster U.S.A., Inc.
  5. Greenheck Fan Corporation.
  6. McGill AirFlow LLC.
  7. Nailor Industries Inc.
  8. Ventfabrics, Inc.
  9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 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. Vision panel.
    - d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  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: Continuous and two compression latches.
    - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
  2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
  3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  4. Factory set at 3.0- to 8.0-inch wg.
  5. Doors close when pressures are within set-point range.
  6. Hinge: Continuous piano.
  7. Latches: Cam.
  8. Seal: Neoprene or foam rubber.
  9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

## 2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Flame Gard, Inc.
  3. 3M.
- B. Labeled according to UL 1978 by an NRTL.

- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

## **2.12 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. Ventfabrics, Inc.
  4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. 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.
- E. 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.
- F. 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.

## **2.13 FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
  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.
- C. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; 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 20 to plus 210 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2007.

D. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

## 2.14 DUCT ACCESSORY HARDWARE

- A. 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.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories 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 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 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.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire and smoke dampers according to UL listing.
- G. 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. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  7. Upstream or downstream from duct silencers.
  8. Control devices requiring inspection.

- 9. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. 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.
- J. Label access doors according to Section 23 0553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- M. Connect diffusers or light troffer boots to ducts directly or with maximum 72-inch lengths of flexible duct clamped or strapped in place, except use rigid elbow for final connection to all diffusers. Limit to, except no flex duct allowed above gypsum ceilings. Support flex duct with strap that is  $\geq 1$ " in width.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Install duct test holes where required for testing and balancing purposes.

### **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 purpose of access door can be performed.
  - 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.

**END OF SECTION**

## SECTION 23 3423

### HVAC POWER VENTILATORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Ceiling-mounted ventilators.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

#### PART 2 - PRODUCTS

##### 2.1 CEILING-MOUNTED VENTILATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Broan-NuTone LLC.
  - 2. Carnes Company.
  - 3. Greenheck Fan Corporation.
  - 4. Loren Cook Company.
  - 5. PennBarry.
  - 6. Twin City.
- B. Housing: Steel, lined with acoustical insulation.

- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
  - 4. Motion Sensor: Motion detector with adjustable shutoff timer.
  - 5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
  - 6. Filter: Washable aluminum to fit between fan and grille.
  - 7. Isolation: Rubber-in-shear vibration isolators.
  - 8. Manufacturer's standard roof jack or wall cap, and transition fittings.

## **2.2 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## **2.3 SOURCE QUALITY CONTROL**

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. .
- B. Support units using restrained spring isolators having a static deflection of 1 inch. Vibration control devices are specified in Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.



- D. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Section 23 0553 "Identification for HVAC Piping and Equipment."

### **3.2 CONNECTIONS**

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 3300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. 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.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. 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.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

### **3.4 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.

- C. Comply with requirements in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

**END OF SECTION**

## SECTION 23 3600

### AIR TERMINAL UNITS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Shutoff, single-duct air terminal units.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal:
  - 1. Materials, fabrication, assembly, and spacing of hangers and supports.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

##### 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace terminal units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. METALAIRE, Inc.
  - 2. Nailor Industries Inc.

3. Price Industries.
  4. Titus.
  5. Envirotec
  6. Trane
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 1/2-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
    - a. Cover liner with nonporous foil.
  2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections, size matching inlet size.
  4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from 0 to 140 deg F, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 6-inch wg inlet static pressure.
  2. Damper Position: Normally open.
- F. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- G. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor.
1. Damper Actuator: 24 V, powered closed, spring return open.
  2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
    - a. Occupied and unoccupied operating mode.
    - b. Remote reset of airflow or temperature set points.
    - c. Adjusting and monitoring with portable terminal.
    - d. Communication with existing temperature-control system.
  3. Room Sensor: Wall mounted, with temperature set-point adjustment and access for connection of portable operator terminal.

## 2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated 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. Steel Cables: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

### **2.3 SOURCE QUALITY CONTROL**

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
  1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

### **3.2 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 and for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

### **3.3 CONNECTIONS**

- A. Install piping adjacent to air terminal unit to allow service and maintenance.

- B. Hot-Water Piping: In addition to requirements in Section 23 2113 "Hydronic Piping" and Section 23 2116 "Hydronic Piping Specialties," Section 15179 "Hydronic Piping Specialties," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Section 23 3113 "Metal Ducts."
- D. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 3300 "Air Duct Accessories."

### **3.4 IDENTIFICATION**

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 23 0553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.
  - 4. Verify that control connections are complete.
  - 5. Verify that nameplate and identification tag are visible.
  - 6. Verify that controls respond to inputs as specified.

### **3.7 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

**END OF SECTION**

**SECTION 23 3713**  
**DIFFUSERS, REGISTERS, AND GRILLES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louver face diffusers.
4. Linear slot diffusers.
5. Fixed face registers and grilles.
6. Linear bar grilles.
7. Fixed, extruded aluminum HVAC louvers.

B. Related Sections:

1. Section 23 3300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

**1.2 ACTION SUBMITTALS**

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

**PART 2 - PRODUCTS**

**2.1 CEILING DIFFUSERS**

A. Rectangular and Square Ceiling Diffusers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.
  - c. METALAIRE, Inc.
  - d. Nailor Industries Inc.
  - e. Price Industries.
  - f. Titus.
  - g. Tuttle & Bailey

B. Perforated Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.
  - c. METALAIRE, Inc.
  - d. Nailor Industries Inc.
  - e. Price Industries.
  - f. Titus.
  - g. Tuttle & Bailey

C. Louver Face Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.
  - c. METALAIRE, Inc.
  - d. Nailor Industries Inc.
  - e. Price Industries.
  - f. Titus.
  - g. Tuttle & Bailey

## 2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.
  - c. METALAIRE, Inc.
  - d. Nailor Industries Inc.
  - e. Price Industries.
  - f. Titus.
  - g. Tuttle & Bailey

## 2.3 REGISTERS AND GRILLES

A. Register and Grilles:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Carnes.
  - b. Krueger.
  - c. Nailor Industries Inc.
  - d. Price Industries.
  - e. Titus.
  - f. Tuttle & Bailey

## 2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver:



1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Aiolite Company, LLC (The).
  - b. Arrow United Industries; a division of Mestek, Inc.
  - c. Dowco Products Group; Safe Air of Illinois.
  - d. Greenheck Fan Corporation.
  - e. NCA Manufacturing, Inc.
  - f. Ruskin Company; Tomkins PLC.
  - g. United Enertech
2. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
3. Mullion Type: Exposed.
4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
5. Louver Screens
  - a. General: Provide screen at each exterior louver.
  - b. Screen Location for Fixed Louvers: Interior face.
  - c. Screening Type: Bird screening.
  - d. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

## **2.5 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install diffusers, registers, louvers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Louver Installation.
  1. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
  2. Form closely fitted joints with exposed connections accurately located and secured.
  3. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

4. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
5. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required.

### **3.2 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- B. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION**

**SECTION 23 5216**  
**CONDENSING BOILERS**

**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, condensing boilers, trim, and accessories for generating hot water.

**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 boilers.
  - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For boilers, boiler trim, and accessories.
  - 1. Include plans, elevations, sections, and [**mounting**] [**attachment**] details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- D. Delegated-Design Submittal: For each boiler.
  - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
    - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
    - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Seismic Qualification Data: Certificates, for boiler, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.
- E. Product Certificates:
1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
  2. CSA B51 pressure vessel Canadian Registration Number (CRN).

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Fire-Tube Condensing Boilers:
    - a. Leakage and Materials: **10** years from date of Substantial Completion.
    - b. Heat Exchanger Damaged by Thermal Stress and Corrosion: for **five** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.

- E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- F. CSA Compliance: Test boilers for compliance with CSA B51.
- G. Mounting Base: For securing boiler to concrete base.
  - 1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 23 0548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

## 2.2 PULSE-COMBUSTION, FIRE-TUBE CONDENSING BOILERS

- A. Description: Factory-fabricated, -assembled, and -tested, pulse-combustion condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls.
- B. Heat Exchanger: **Type 316L, stainless-steel** primary and secondary combustion chamber.
- C. Pressure Vessel: Carbon steel with welded heads and tube connections.
- D. Exhaust Decoupler: Fiberglass composite material in a corrosion-resistant steel box.
- E. Burner: Natural gas, self-aspirating and self-venting after initial start.
- F. Blower: Centrifugal fan to operate only during start of each burner sequence.
  - 1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."
    - a. 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.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- I. Casing:
  - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
  - 2. Control Compartment Enclosure: NEMA 250, Type 1A.
  - 3. Finish: Powder-coated protective finish.
  - 4. Insulation: Minimum 2-inch- (50-mm-) thick, mineral-fiber insulation surrounding heat exchanger.
  - 5. Combustion-Air Connection: Inlet duct collar and sheet metal closure over burner compartment.
- J. Mufflers: Carbon-steel intake muffler and stainless-steel exhaust.
- K. Condensate Trap: Cast-iron body with stainless-steel internal parts.

L. Capacities and Characteristics:

M. Hot-Water Heating:

1. Design Water-Pressure Rating: 150 psig (1035 kPa).
2. Entering-Water Temperature: 160 F.
3. Leaving-Water Temperature: 180 F.
4. Design Water Flow Rate: 150 gpm .
5. Design Pressure Drop: 4 psig .

6. Electrical Characteristics:

- a. Volts: 115 V.
- b. Phase: Single.
- c. Hertz: 60Hz.
- d. Full-Load Amperes: 8 A.

N. Safety Relief Valve:

1. Size and Capacity: As required for equipment according to 2010 ASME Boiler and Pressure Vessel Code.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.
  - a. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.

O. Pressure Gage: Minimum 3-1/2-inch (89-mm) diameter. Gage shall have normal operating pressure about 50 percent of full range.

P. Water Column: Minimum 12-inch (300-mm) glass gage with shutoff cocks.

Q. Drain Valves: Minimum NPS 3/4 (DN 20) or nozzle size with hose-end connection.

R. Blowdown Valves: Factory-installed bottom and surface, slow-acting blowdown valves same size as boiler nozzle.

S. Stop Valves: Boiler inlets and outlets, except safety relief valves or preheater inlet and outlet, shall be equipped with stop valve in an accessible location as near as practical to boiler nozzle and same size or larger than nozzle. Valves larger than NPS 2 (DN 50) shall have rising stem.

T. Stop-Check Valves: Factory-installed, stop-check valve and stop valve at boiler outlet with free-blow drain valve factory installed between the two valves and visible when operating stop-check valve.

## 2.3 CONTROLS

A. Refer to Section 23 0923 "Direct Digital Control (DDC) System for HVAC" and Section 23 0993.11 "Sequence of Operations for HVAC DDC."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.

3. Operating Pressure Control: Factory wired and mounted to cycle burner.
  4. Low-Water Cutoff and Pump Control: Cycle feedwater pump(s) for makeup water control.
  5. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
    - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
    - b. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
  6. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain a constant steam pressure. Maintain pressure set point plus or minus 10 percent.
    - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
- C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
1. High Cutoff: **Automatic** reset stops burner if operating conditions rise above maximum boiler design
  2. Low-Water Cutoff Switch: **Electronic** probe shall prevent burner operation on low water. Cutoff switch shall be **automatic**-reset type.
  3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
  4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.
1. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

## 2.4 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.
- B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

## **2.5 VENTING KITS**

- A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
- B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

## **2.6 SOURCE QUALITY CONTROL**

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.
- C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.
  - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 BOILER INSTALLATION**

- A. Equipment Mounting:
  - 1. Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations
  - 2. Comply with requirements for vibration isolation and seismic-restraint devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC."
  - 3. Comply with requirements for vibration isolation devices specified in Section 23 0548.13 "Vibration Controls for HVAC."
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.



- E. Install control wiring to field-mounted electrical devices.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 23 2116 "Hydronic Piping Specialties."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- G. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tapplings with shutoff valve and union or flange at each connection.
- H. Install piping from safety relief valves to nearest floor drain.
- I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.
- J. Boiler Venting:
  - 1. Install flue venting kit and combustion-air intake.
- K. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform installation and startup checks according to manufacturer's written instructions.
  - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
  - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
  
- D. Boiler will be considered defective if it does not pass tests and inspections.
  
- E. Prepare test and inspection reports.
  
- F. 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.
  
- G. Performance Tests:
  1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
  2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
  3. Perform field performance tests to determine capacity and efficiency of boilers.
    - a. Test for full capacity.
    - b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100 percent of full capacity. Determine efficiency at each test point.
  4. Repeat tests until results comply with requirements indicated.
  5. Provide analysis equipment required to determine performance.
  6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
  7. Notify Architect **24** hours minimum in advance of test dates.
  8. Document test results in a report and submit to Architect.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train] Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 01 7900 "Demonstration and Training."

**END OF SECTION**

## SECTION 23 5533

### FUEL-FIRED UNIT HEATERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes gas-fired unit heaters.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of fuel-fired unit heater indicated. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power wiring.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

##### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger of fuel-fired unit heater that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

#### PART 2 - PRODUCTS

##### 2.1 GAS-FIRED UNIT HEATERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Lennox Industries, Inc.
  2. Modine Manufacturing Company.
  3. Reznor/Thomas & Betts Corporation.
  4. Sterling HVAC Products; Div. of Mestek Technology Inc.
  5. Trane
- C. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- D. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- E. Type of Venting: Powered vented.
- F. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
- G. Heat Exchanger: Stainless steel.
- H. Burner Material: Aluminized steel with stainless-steel inserts.
- I. Unit Fan: Propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
- J. 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 or Differential pressure switch to verify open vent.
  5. Control transformer.
  6. High Limit: Thermal switch or fuse to stop burner.
  7. Thermostats: Devices and wiring are specified in Section 23 0900 "Instrumentation and Control for HVAC."
  8. Thermostat: Single-stage, wall-mounting type with 50 to 90 deg F operating range and fan on switch.
  9. Thermostat: 2-stage, wall-mounting type with 50 to 90 deg F operating range and fan on switch.
  10. Thermostat: Single-stage type with duct-mounting sensor and 50 to 90 deg F operating range.
  11. Thermostat: 2-stage type with duct-mounting sensor and 50 to 90 deg F operating range.
- K. Discharge Louvers: Independently adjustable horizontal blades.
- L. Accessories:
1. Vertical discharge louvers.
  2. Four-point suspension kit.
  3. Summer fan switch.
  4. Unit-mounted thermostat bracket.
  5. Power Venter: Centrifugal aluminized-steel fan, with stainless-steel shaft; 120-V ac motor.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install and connect gas-fired unit heaters and associated fuel and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.
- B. 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.
- C. Install piping adjacent to fuel-fired unit heater to allow service and maintenance.
- D. Gas Piping: Comply with Section 23 1123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- E. Vent Connections: Comply with Section 23 5100 "Breechings, Chimneys, and Stacks."
- F. Electrical Connections: Comply with applicable requirements in electrical Sections.
  - 1. Install electrical devices furnished with heaters but not specified to be factory mounted.
- G. Adjust initial temperature set points.
- H. Adjust burner and other unit components for optimum heating performance and efficiency.

### **3.2 FIELD QUALITY CONTROL**

- A. Tests and Inspections: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**END OF SECTION**

## SECTION 23 6426.21

### AIR-COOLED, ROTARY-SCREW WATER CHILLERS

#### 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. Packaged, air-cooled chillers.
  - 2. Packaged, portable refrigerant recovery units.
  - 3. Heat-exchanger, brush-cleaning system.

##### 1.3 DEFINITIONS

- A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- B. DDC: Direct digital control.
- C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- E. kW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.
- F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and intended for operating conditions other than AHRI standard rating conditions.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
  - 2. Performance at AHRI standard conditions and at conditions indicated.
  - 3. Performance at AHRI standard unloading conditions.
  - 4. Minimum evaporator flow rate.

5. Refrigerant capacity of chiller.
6. Oil capacity of chiller.
7. Fluid capacity of evaporator.
8. Characteristics of safety relief valves.
9. Minimum entering condenser-air temperature.
10. Maximum entering condenser-air temperature.
11. Performance at varying capacities with constant-design, entering condenser-air temperature. Repeat performance at varying capacities for different entering condenser-air temperatures from design to minimum in [10 deg F (6 deg C)] increments.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

## 1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor 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. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Seismic Qualification Data: Certificates, for chillers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Field Quality-Control Reports: Startup service reports.

F. Sample Warranty: For AHRI special warranty.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- A. AHRI Certification: Certify chiller according to AHRI 590 certification program(s).
- B. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590.
- C. ASHRAE Compliance:
  - 1. ASHRAE 15 for safety code for mechanical refrigeration.
  - 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- E. ASME Compliance: Fabricate and label chiller to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and include an ASME U-stamp and nameplate certifying compliance.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Ship chillers from the factory fully charged with refrigerant.
- B. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.
- C. Ship each oil-lubricated chiller with a full charge of oil.
  - 1. Ship oil factory installed in chiller]
- D. Package chiller for export shipping in totally enclosed crate

## **1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of chillers that fail in materials or workmanship within specified warranty period.
  - 1. Extended warranties include, but are not limited to, the following:
    - a. Complete chiller including refrigerant and oil charge.
    - b. Complete compressor and drive assembly including refrigerant and oil charge.
    - c. Refrigerant and oil charge.
    - d. Parts only and labor.
    - e. Loss of refrigerant charge for any reason.
  - 2. Warranty Period: Five years from date of Substantial Completion.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Performance Tolerance: Comply with the following in lieu of AHRI 550/590:
  - 1. Allowable Capacity Tolerance: **Zero** percent.
  - 2. Allowable IPLV/NPLV Performance Tolerance: **Zero** percent.

### 2.2 PACKAGED, AIR-COOLED CHILLERS

- A. Description: Factory-assembled and run-tested chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.
- B. Fabricate base, frame, and attachment to chiller components strong enough to resist chiller movement during a seismic event when chiller base is anchored to field support structure.
- C. Cabinet:
  - 1. Base: Galvanized-steel base extending the perimeter of chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
  - 2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported by base.
  - 3. Casing: Galvanized steel.
  - 4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a **500** hour salt-spray test according to ASTM B 117.
  - 5. Sound-reduction package designed to reduce sound level without affecting performance and consisting of the following:
    - a. Acoustic enclosure around compressors.
    - b. Reduced-speed fans with acoustic treatment.
  - 6. Security Package: Provide removable **louvered panels** with fasteners for additional protection of compressors, evaporator, and condenser coils without inhibiting service access. Finish to match cabinet.
- D. Compressors:
  - 1. Description: Positive displacement, hermetically sealed.
  - 2. Casing: Cast iron, precision machined for minimum clearance about periphery of rotors.
  - 3. Rotors: Manufacturer's standard one- or two-rotor design.
  - 4. Each compressor provided with suction and discharge shutoff valves, crankcase oil heater, and suction strainer.
- E. Service: Easily accessible for inspection and service.
- F. Capacity Control: On-off compressor cycling and modulating slide-valve assembly or port unloaders combined with hot-gas bypass, if necessary, to achieve performance indicated.
  - 1. Maintain stable operation throughout range of operation. Configure to achieve most energy-efficient operation possible.

2. Operating Range: From 100 to zero percent of design capacity.
  3. For units equipped with a variable-frequency controller, capacity control shall be both "valveless" and "stepless," requiring no slide valve or capacity-control valve(s) to operate at reduced capacity.
- G. Oil Lubrication System: Consisting of pump if required, filtration, heater, cooler, factory-wired power connection, and controls.
1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, shutdown, and standby conditions including power failure.
  2. Thermostatically controlled oil heater properly sized to remove refrigerant from oil.
  3. Factory-installed and pressure-tested piping with isolation valves and accessories.
  4. Oil compatible with refrigerant and chiller components.
  5. Positive visual indication of oil level.
- H. Vibration Control:
1. Vibration Balance: Balance chiller compressors and drive assemblies to provide a precision balance that is free of noticeable vibration over the entire operating range.
    - a. Overspeed Test: 25 percent above design operating speed.
  2. Isolation: Mount individual compressors on vibration isolators.
- I. Compressor Motors:
1. Hermetically sealed and cooled by refrigerant suction gas.
  2. High-torque, induction type with inherent thermal-overload protection on each phase.
- J. Compressor Motor Controllers:
1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.
  2. Star-Delta, Reduced-Voltage Controller: NEMA ICS 2, closed transition.
  3. Solid-state controller.
  4. Variable-Frequency Controller:
    - a. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
    - b. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
    - c. Enclosure: Unit mounted, NEMA 250 Type 3R , with hinged full-front access door with lock and key.
    - d. Integral Disconnecting Means: Door-interlocked UL 489, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system
    - e. Technology: Pulse-width-modulated output suitable for constant or variable torque loads.
    - f. Motor current at start shall not exceed the rated load amperes, providing no electrical inrush.
- K. Refrigerant Circuits:
1. Refrigerant: Type as indicated on Drawings.
  2. Refrigerant Type:[R-410a. Classified as Safety Group A1 according to ASHRAE 34.
  3. Refrigerant Compatibility: Chiller parts exposed to refrigerants shall be fully compatible

- with refrigerants, and pressure components shall be rated for refrigerant pressures.
4. Refrigerant Circuit: Each shall include a thermal- or electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor and discharge shutoff valves, a liquid-line shutoff valve, a filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
  5. Pressure Relief Device:
    - a. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
    - b. ASME-rated, spring-loaded pressure relief valve; single- or multiple-reseating type.

L. Evaporator:

1. Description: Shell-and-tube design.
  - a. Direct-expansion type with fluid flowing through the shell, and refrigerant flowing through the tubes within the shell.
  - b. Flooded type with fluid flowing through tubes and refrigerant flowing around tubes within the shell.
2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Shell Material: Carbon steel.
4. Shell Heads: Removable carbon-steel heads located at each end of the tube bundle.
5. Fluid Nozzles: Terminated with **flanged** end connections for connection to field piping.
6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
7. Heater: Factory-installed and -wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F (minus 29 deg C).

M. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig (3103 kPa).
  - a. Construct coil casing of **stainless** steel.
  - b. Coat coils with a baked-epoxy, corrosion-resistant coating after fabrication.
  - c. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed nonventilating or totally enclosed air over enclosure, with permanently lubricated bearings. Equip each motor with overload protection integral to either the motor or chiller controls.
4. Fan Guards: Steel safety guards with corrosion-resistant coating.

N. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point, field-power connection to chiller.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.

- a. Disconnect means shall be interlocked with door operation.
  - b. Minimum withstand rating shall be as required by electrical power distribution system
5. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
- a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
  - b. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.
6. Provide each motor with overcurrent protection.
7. Overload relay sized according to UL 1995 or an integral component of chiller control microprocessor.
8. Phase-Failure and Undervoltage Relays: Solid-state sensing with adjustable settings.
9. Control Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- a. Power unit-mounted controls where indicated.
  - b. Power unit-mounted, ground fault interrupt duplex receptacle.
10. Control Relays: Auxiliary and adjustable time-delay relays.
11. For chiller electrical power supply, indicate the following:
- a. Current and phase to phase for all three phases.
  - b. Voltage, phase to phase, and phase to neutral for all three phases.
  - c. Three-phase real power (kilowatts).
  - d. Three-phase reactive power (kilovolt amperes reactive).
  - e. Power factor.
  - f. Running log of total power versus time (kilowatt-hours).
  - g. Fault log, with time and date of each.

O. Controls:

- 1. Standalone and microprocessor based.
- 2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure
- 3. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units, display the following information:
  - a. Date and time.
  - b. Operating or alarm status.
  - c. Operating hours.
  - d. Outdoor-air temperature if required for chilled-water reset.
  - e. Temperature and pressure of operating set points.
  - f. Entering and leaving temperatures of chilled water.
  - g. Refrigerant pressures in evaporator and condenser.
  - h. Saturation temperature in evaporator and condenser.
  - i. No cooling load condition.
  - j. Elapsed time meter (compressor run status).
  - k. Pump status.
  - l. Antirecycling timer status.
  - m. Percent of maximum motor amperage.

- n. Current-limit set point.
  - o. Number of compressor starts.
4. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:
- a. Low evaporator pressure or high condenser pressure.
  - b. Low chilled-water temperature.
  - c. Refrigerant high pressure.
  - d. High or low oil pressure.
  - e. High oil temperature.
  - f. Loss of chilled-water flow.
  - g. Control device failure.
5. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.
6. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.
7. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.
8. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display chiller status and alarms.
- a. **ASHRAE 135 (BACnet)** communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the chiller from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the DDC system for HVAC.

P. Insulation:

- 1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
- 2. Factory-applied insulation over cold surfaces of chiller components.
  - a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
- 3. Apply protective coating to exposed surfaces of insulation to protect insulation from weather.

Q. Accessories:

- 1. Factory-furnished, chilled-water flow switches for field installation.
- 2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigerant circuit.
- 3. Factory-furnished [**neoprene**] [**or**] [**spring**] isolators for field installation.
- 4. Tool Kit: Chiller manufacturer shall assemble a tool kit specially designed for use in serving the chiller(s) furnished. Include special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance. Place tools in a lockable case with hinged cover. Provide a list of each tool furnished and attach the list to underside of case cover.

- R. Capacities and Characteristics:
  - 1. Control Electrical Requirements:
    - a. Volts: **120** V ac.
    - b. Phase: Single.
    - c. Hertz: 60.
  - 2. Chiller Electrical Requirements:
    - a. Volts: **600**.
    - b. Phase: Three.
    - c. Hertz: 60.

## **2.3 PACKAGED, PORTABLE REFRIGERANT RECOVERY UNITS**

- A. Packaged, portable unit consisting of compressor, air-cooled condenser, recovery system, tank pressure gages, filter-dryer, and valving that allows for switching between liquid and vapor recovery mode. Refrigerant recovery unit shall be factory mounted on an ASME-constructed and -stamped refrigerant storage vessel that is sized to hold the full refrigerant charge of the largest chiller furnished.

## **2.4 SOURCE QUALITY CONTROL**

- A. Perform functional tests of chillers before shipping.
- B. Factory run test each air-cooled chiller with water flowing through evaporator.
- C. Factory performance test air-cooled chillers, before shipping, according to AHRI 550/590.
- D. Factory sound test air-cooled chillers, before shipping, according to AHRI 370.
- E. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. For chillers located indoors, rate sound power level according to AHRI 575.
- G. For chillers located outdoors, rate sound power level according to AHRI 370.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine chillers before installation. Reject chillers that are damaged.
- B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.
  - 1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 CHILLER INSTALLATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- D. Install chillers on support structure indicated.
- E. Equipment Mounting:
  - 1. Install chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations
  - 2. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC."
  - 3. Comply with requirements for vibration isolation devices specified in Section 23 0548.13 "Vibration Controls for HVAC."
- F. Maintain manufacturer's recommended clearances for service and maintenance.
- G. Charge chiller with refrigerant and fill with oil if not factory installed.
- H. Install separate devices furnished by manufacturer and not factory installed.

### **3.3 CONNECTIONS**

- A. Comply with requirements for piping specified in Section 23 2113 "Hydronic Piping," Section 23 2116 Hydronic Piping Specialties," Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage flow meter, and drain connection with valve. Make connections to chiller with a flange
- D. Condenser Fluid Connections: Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to condenser outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, flow meter, and drain connection with valve. Make connections to chiller with a flange.

### **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. Verify that refrigerant charge is sufficient and chiller has been leak tested.
  - 3. Verify that pumps are installed and functional.
  - 4. Verify that thermometers and gages are installed.
  - 5. Operate chiller for run-in period.
  - 6. Check bearing lubrication and oil levels.
  - 7. For chillers installed indoors, verify that refrigerant pressure relief device is vented outdoors.
  - 8. Verify proper motor rotation.
  - 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
  - 10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
  - 11. Verify and record performance of chiller protection devices.
  - 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Prepare test and inspection startup reports.

### **3.5 DEMONSTRATION**

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

**END OF SECTION**



## SECTION 23 7313

### MODULAR INDOOR CENTRAL-STATION AIR-HANDLING 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. Variable-air-volume, single-zone air-handling units.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each air-handling unit indicated.
  - 1. Unit dimensions and weight.
  - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
  - 3. Fans:
    - a. Certified fan-performance curves with system operating conditions indicated.
    - b. Certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  - 4. Certified coil-performance ratings with system operating conditions indicated.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Filters with performance characteristics.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.

2. Support location, type, and weight.
  3. Field measurements.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and 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. Filters: One set(s) for each air-handling unit.
  2. Gaskets: One set(s) for each access door.
  3. Fan Belts: One set(s) for each air-handling unit fan.

#### **1.8 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

#### **1.9 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of MFR indicated on drawings.

### **2.2 UNIT CASINGS**

- A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant.
4. Factory Finish for Steel and Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- B. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type I.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
  - a. Liner Adhesive: Comply with ASTM C 916, Type I.
  - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
  - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.

- C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
  - a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
  - b. Gasket: Neoprene, applied around entire perimeters of panel frames.
  - c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
  - a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.

- b. Gasket: Neoprene, applied around entire perimeters of panel frames.
  - 4. Locations and Applications:
    - a. Fan Section: Doors.
    - b. Access Section: Doors.
    - c. Coil Section: Doors.
    - d. Damper Section: Doors.
    - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
    - f. Mixing Section: Doors.
- D. Condensate Drain Pans:
  - 1. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
    - a. Length: Extend drain pan downstream from leaving face
    - b. Depth: A minimum of 2 inches deep.
  - 2. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
  - 3. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
- E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

## 2.3 FAN, DRIVE, AND MOTOR SECTION

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
  - 1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
    - a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
    - b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
  - 1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  - 2. Horizontal-Flanged, Split Housing: Bolted construction.
  - 3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.
  - 4. Flexible Connector: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized-steel sheet or 0.032-inch- thick aluminum sheets; select metal compatible with casing.
    - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics,

coatings, and adhesives shall comply with UL 181, Class 1.

- 1) Fabric Minimum Weight: 26 oz./sq. yd..
  - 2) Fabric Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3) Fabric Service Temperature: Minus 40 to plus 200 deg F.
- C. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.
- D. Backward-Inclined, Centrifugal Fan Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. Fan Shaft Bearings:
1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 50,000 hours according to ABMA 9.
- F. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 [1.2] service factor based on fan motor.
1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
  2. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
  3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.
- G. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
- H. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."
1. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  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.
  3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

## 2.4 COIL SECTION

- A. General Requirements for Coil Section:
1. Comply with ARI 410.
  2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
  3. Coils shall not act as structural component of unit.

## 2.5 AIR FILTRATION SECTION

- A. General Requirements for Air Filtration Section:
1. Comply with NFPA 90A.
  2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
  4. Factory Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.
- B. Filter Gage:
1. 3-1/2-inch- diameter, diaphragm-actuated dial in metal case.
  2. Vent valves.
  3. Black figures on white background.
  4. Front recalibration adjustment.
  5. 2 percent of full-scale accuracy.
  6. Range: 0- to 2.0-inch wg.
  7. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch aluminum tubing, and 2- or 3-way vent valves.

## 2.6 DAMPERS

- A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.
- B. Damper Operators: Comply with requirements in Section 23 0900 "Instrumentation and Control for HVAC."
- C. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in parallel-blade arrangement with steel operating rods rotating in sintered bronze or nylon bearings mounted in a single aluminum frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.
- D. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.
- E. Combination Filter and Mixing Section:
1. Cabinet support members shall hold 2-inch- thick, pleated, flat, permanent or throwaway filters.
  2. Multiple-blade, air-mixer assembly shall mix air to prevent stratification, located immediately downstream of mixing box.

## **2.7 SOURCE QUALITY CONTROL**

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Steam Coils: Factory tested to 300 psig and to 200 psig underwater according to ARI 410 and ASHRAE 33.
- E. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Section 03 3000 "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Section 23 0548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
  - 1. Minimum Deflection: 1/2 inch.
  - 2. Install galvanized-steel plate to equally distribute weight over elastomeric pad.
  - 3. 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.
  - 4. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 6. Install anchor bolts to elevations required for proper attachment to supported equipment.

- B. Arrange installation of units to provide access space around air-handling units for service and maintenance.
- C. 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.
- D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

### **3.3 CONNECTIONS**

- A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 23 2113 "Hydronic Piping" and Section 23 2116 Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 3300 "Air Duct Accessories."

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
  - 2. Charge refrigerant coils with refrigerant and test for leaks.
  - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.



- D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.5 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that shipping, blocking, and bracing are removed.
  - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
  - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
  - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
  - 6. Verify that zone dampers fully open and close for each zone.
  - 7. Verify that face-and-bypass dampers provide full face flow.
  - 8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
  - 9. Comb coil fins for parallel orientation.
  - 10. Verify that proper thermal-overload protection is installed for electric coils.
  - 11. Install new, clean filters.
  - 12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
  - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.
  - 2. Measure and record motor electrical values for voltage and amperage.
  - 3. Manually operate dampers from fully closed to fully open position and record fan performance.

### **3.6 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

### **3.7 CLEANING**

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

**3.8 DEMONSTRATION**

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

**END OF SECTION**

## SECTION 23 7500

### HVAC SILENCERS

#### 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. Duct silencers.
- B. Related Sections:
  - 1. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment".

##### 1.3 SUBMITTALS

- A. Performance Data:
  - 1. Silencer manufacturer to provide submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.
  - 2. The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will **meet NC-35 to NC40 in the noise critical spaces.**

#### PART 2 - PRODUCTS

##### 2.1 DUCT SILENCERS

- A. Basis-of-Design Product: Silencers shall be Vibro-Acoustics.
  - 1. Alternate manufacturers must request and obtain written approval by the Engineer to bid the project at least 10 days prior to the bid due-date.
- B. General Requirements:
  - 1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.

2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
  3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
  4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
  5. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.
  6. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill and sealants shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
  7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2007.
- C. Rectangular Elbow Silencers including models RED and EX-RED: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, 18 gauge. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 48" shall have at least two half splitters and one full splitter.
- D. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.
1. Rectangular Elbow Silencers: 22 gauge
- E. Principal Sound-Absorbing Mechanism:
1. Dissipative silencers:
    - a. Models **RED and EX-RED** type with acoustic media. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.

**F. Capacities and Characteristics:**

See duct silencer performance schedule on mechanical drawings. Alternate manufacturer has to provide acoustical analysis to the Mechanical Consultant showing silencers meet NC-35 to NC40 in the noise critical spaces.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install silencer according to manufacturer's written installation instructions.

### **3.2 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Ensure duct silencers are installed with airflow arrows in direction of airflow.

**END OF SECTION**

## SECTION 25 5050

### DIRECT DIGITAL CONTROLS SYSTEM

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

##### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Installed But Not Supplied Under This Section:
  - 1. Thermostats with standalone units.
- B. Products Not Furnished or Installed But Integrated with the Work of This Section:
  - 1. Smoke detectors (through alarm relay contacts).
- C. Work Required Under Other Divisions Related to This Section:
  - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
  - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
  - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.
  - 4. Electrical submeters provided and installed by Electrical Contractor. Submeters to be provided with BACnet ms/tp communication.
  - 5. Solar Panel System and associated power meters
  - 6. Television display of Solar Panel System savings. Controls contractor to provide custom graphic appropriate for public display of Solar Panel system power data.

##### 1.3 RELATED SECTIONS

- A. Section 23 0500 - Common Work Results for HVAC.

##### 1.4 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer BACnet protocol bus.
  - 1. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via protocols including, as a minimum, LonTalk, BACnet and MODBUS.
  - 2. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
  - 3. Any control vendor that shall provide additional BMS server software shall be unacceptable.
  - 4. The BMS server or Master Controller shall host all graphic files for the control system.
  - 5. Provide all hardware, software, programming tools and documentation necessary to modify the system, accommodate system expansion, and facilitate changes in operation on site. Modification includes addition and deletion of devices, circuits, and changes to system operation and custom label changes for devices and circuits. The system structure and software shall place no limit on the type or extent of software

- modifications on-site.
6. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
  7. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
- B. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.
  2. FCC, Part 15, Subpart B, Class B
  3. FCC, Part 15, Subpart C
  4. FCC, Part 15, Subpart J, Class A Computing Devices.
  5. UL 504 - Industrial Control Equipment.
  6. UL 506 - Specialty Transformers.
  7. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.
  8. UL 916 - Energy Management Systems All.
  9. UL 1449 - Transient Voltage Suppression.
  10. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
  11. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
  12. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
  13. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
  14. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
    - a. NEMA 250 - Enclosures for Electrical Equipment.
  15. NEMA ICS 1 - Industrial Controls and Systems.
  16. NEMA ST 1 - Specialty Transformers.
  17. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.
  18. CE 61326.
  19. C-Tick.
  20. cUL.

## 1.5 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
  2. AI: Analog Input.
  3. AO: Analog Output.
  4. Analog: Continuously variable state over stated range of values.
  5. BMS: Building Management System.
  6. DDC: Direct Digital Control.
  7. Discrete: Binary or digital state.
  8. DI: Discrete Input.

9. DO: Discrete Output.
10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
12. GUI: Graphical User Interface.
13. HVAC: Heating, Ventilating and Air Conditioning.
14. IDC: Interoperable Digital Controller.
15. ILC: Interoperable Lon Controller.
16. LAN: Local Area Network.
17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
18. Motorized: Control device with actuator.
19. NAC: Network Area Controller.
20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
23. Operator: Same as actuator.
24. PC: Personal Computer.
25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
28. PICS: BACnet Product Interoperability Compliance Statement.
29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
30. Point: Analog or discrete instrument with addressable database value.
31. WAN: Wide Area Network.

## 1.6 SUBMITTALS

- A. Submit under provisions of Section 01 3000 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Catalog Information
  2. Detailed Product Information / Data Sheets
  3. Installation and/or Maintenance Instructions
- C. Submit documentation of contractor qualifications if requested by the A-E.
- D. Five copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.



- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide 5 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and on digital media.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

## **1.7 QUALITY ASSURANCE**

- A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified.
- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

## **1.8 DELIVERY, STORAGE AND HANDLING**

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

## **1.9 JOB CONDITIONS**

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

## **1.10 SEQUENCING**

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers:

1. KMC Controls as provided by Harrison Energy Partners
- B. Substitutions: Engineer Approval Required

## **2.2 GENERAL**

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

## **2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE**

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment shall be via BACnet ms/tp or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
  1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
  2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

## **2.4 BAS SERVER HARDWARE**

- A. Minimum Computer Configuration (Hardware Independent).
  1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
  2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
  3. Memory: 2 GB or more recommended for large systems
  4. Hard Drive: 256 GB minimum, more recommended depending on archiving requirements.

5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
  6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
  7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

## 2.5 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers, application specific controllers and advanced unitary controllers which are connected to its communications trunks, manage communications between itself and other system network controllers, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
  1. BACnet
  2. Lon
  3. MODBUS
  4. SNMP
  5. KNX
- G. The SNC shall be capable of executing application control programs to provide:
  1. Calendar functions.
  2. Scheduling.
  3. Trending.
  4. Alarm monitoring and routing.
  5. Time synchronization.
  6. Integration of LonWorks, BACnet, and MODBUS controller data.
  7. Network management functions for all SNC, PEC and ASC based devices.
- H. The SNC shall provide the following hardware features as a minimum:
  1. Two 10/100 Mbps Ethernet ports.
  2. Two Isolated RS-485 ports with biasing switches.
  3. 1 GB RAM
  4. 4 GB Flash Total Storage / 2 GB User Storage

5. Wi-Fi (Client or WAP)
  6. USB Flash Drive
  7. High Speed Field Bus Expansion
  8. -20-60 degreesC Ambient Operating Temperature
  9. Integrated 24 VAC/DC Global Power Supply
  10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
  - J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
  - K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
    1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
      - a. Alarm.
      - b. Return to normal.
      - c. To default.
    2. Alarms shall be annunciated in any of the following manners as defined by the user:
      - a. Screen message text.
      - b. Email of complete alarm message to multiple recipients.
      - c. Pagers via paging services that initiate a page on receipt of email message.
      - d. Graphics with flashing alarm object(s).
    3. The following shall be recorded by the SNC for each alarm (at a minimum):
      - a. Time and date.
      - b. Equipment (air handler #, access way, etc.).
      - c. Acknowledge time, date, and user who issued acknowledgement.
  - L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
  - M. The SNC shall support the following security functions.
    1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
    2. Role-Based Access Control (RBAC) for managing user roles and permissions.
    3. Require users to use strong credentials.
    4. Data in Motion and Sensitive Data at Rest be encrypted.
    5. LDAP and Kerberos integration of access management.
  - N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
    1. Metadata: Descriptive tags to define the structure of properties.
    2. Tagging: Process to apply metadata to components
    3. Tag Dictionary
  - O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD.) shall have an associated template file for reuse on future project additions.

## **2.6 PROGRAMMABLE EQUIPMENT CONTROLLER (PEC)**

- A. HVAC control shall be accomplished using BACnet based devices where the application has a BTL Listed PICS defined. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
- B. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
- D. The PEC shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the Niagara 4 environment.
- E. The following integral and remote Inputs/Outputs shall be supported per each PEC:
  - 1. Digital inputs.
  - 2. Analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).
  - 3. Analog outputs.
  - 4. Digital outputs, configurable as maintained or floating motor control outputs.
  - 5. One integral power supply for auxiliary devices.
  - 6. If a 20 Vdc 65-mA power supply terminal is not integral to the PEC, provide at each PEC a separate, fully isolated, enclosed, current limited and regulated UL listed auxiliary power supply for power to auxiliary devices.
- F. Each PEC shall have expansion ability to support additional I/O requirements through the use of remote input/output modules.
- G. PEC Controllers shall support at minimum the following control techniques:
  - 1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
  - 2. General-purpose, non-linear control loops.
  - 3. Start/stop Loops.
  - 4. If/Then/Else logic loops.
  - 5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).

## 2.7 OTHER CONTROL SYSTEM HARDWARE

- A. Wall Mount Room Temperature sensors: Room temperature sensors will be provided with HVAC equipment package. Each room temperature sensor shall provide temperature indication to the factory, digital controller, provide the capability for a software-limited occupant set point adjustment and limited operation override capability. Remote adjustment of room set points and limits of set points shall be adjustable from the BMS.
- B. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 10 to 95% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 122 degrees F.
- C. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus three percent (3%) or

40 PPM, whichever is greater. Response shall be less than two minutes. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC.

- D. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.
- E. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.
- F. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips.
- G. Temperature Control Panels: Furnish temperature control panels of code gauge steel with hinged doors for each DDC controller. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- H. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of  $\pm 1\%$  accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.
- I. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.
- J. Variable Frequency Drives: The variable frequency drives (VFD) for this project shall be provided factory installed with the HVAC equipment.
- K. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- L. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- M. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

## **2.8 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW**

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate

using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.

- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
  - 1. Trending.
  - 2. Scheduling.
  - 3. Electrical demand limiting.
  - 4. Duty Cycling.
  - 5. Downloading Memory to field devices.
  - 6. Real time 'live' Graphic Programs.
  - 7. Tree Navigation.
  - 8. Parameter change of properties.
  - 9. Set point adjustments.
  - 10. Alarm / event information.
  - 11. Configuration of operators.
  - 12. Execution of global commands.
  - 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
  - 1. Server Software, Database and Web Browser Graphical User Interface.
  - 2. 1 Year Software Maintenance license.
  - 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
  - 4. Embedded Graphical Programming Tools.
  - 5. Embedded Direct Digital Control software.
  - 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
  - 1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
  - 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

## 2.9 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
  2. Groups View shall display Scheduled Groups and custom reports.
  3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
  2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
  3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
  4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
  5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
  6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
  7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.



8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
  9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
  2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
  3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
  4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
  5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
    - a. Each piece of equipment monitored or controlled including each terminal unit.
    - b. Each building.
    - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
    - a. Types of schedule shall be Normal, Holiday or Override.
    - b. A specific date.
    - c. A range of dates.
    - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
    - e. Wildcard (example, allow combinations like second Tuesday of every month).
  2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
  3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the

operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.

4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
  5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
  6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
  2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
  3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
  4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
  5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
  6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
  7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
  8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted

from the database and archived to a text file after an operator defined period.

9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
  - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
  - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
  - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
  - d. Write Property: The write property reporting action updates a property value in a hardware module.
  - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
  - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.

H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.

1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).

I. Security Access: Systems that are accessed from the web browser GUI to BAS server shall

require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:

1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
  - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
  - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
  - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

## 2.10 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
  1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
  2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
  3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be

- submitted with the control contractors bid.
4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
  5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
  6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
  7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
  8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
  9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
  10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### **3.3 GENERAL**

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

#### **3.4 WIRING**

- A. All electrical control wiring to the control panels shall be the responsibility of the Control

System Contractor.

- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

### **3.5 ACCEPTANCE TESTING**

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

### **3.6 OPERATOR TRAINING**

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 8 total hours of comprehensive training for system orientation, product maintenance, and troubleshooting, The training shall start after final commissioning.

### **3.7 WARRANTY PERIOD SERVICES**

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a

period of one year from the time of system acceptance.

- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- D. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- E. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

### **3.8 WARRANTY ACCESS**

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

### **3.9 OPERATION & MAINTENANCE MANUALS**

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
  1. As-built control drawings for all equipment.
  2. As-built Network Communications Diagram.
  3. General description and specifications for all components.
  4. Completed Performance Verification sheets.
  5. Completed Controller Checkout/Calibration Sheets.

### **3.10 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION**

## SECTION 26 0519

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Metal-clad cable, Type MC, rated 600 V or less.
4. Armored cable, Type AC, rated 600 V or less.
5. Photovoltaic cable, Type PV, rated 2000 V or less.
6. Mineral-insulated cable, Type MI, rated 600 V or less.
7. Tray cable, Type TC, rated 600 V or less.
8. Fire-alarm wire and cable.
9. Connectors, splices, and terminations rated 600 V and less.

###### B. Related Requirements:

1. Section 26 0513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.
2. Section 26 0523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 27 1313 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
4. Section 27 1513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

##### 1.2 DEFINITIONS

- A. PV: Photovoltaic.
- B. RoHS: Restriction of Hazardous Substances.
- C. VFC: Variable-frequency controller.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Product Schedule: Indicate type, use, location, and termination locations.



## 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer's authorized service representative.
- B. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B496 for stranded conductors.
- D. Conductor Insulation:
  - 1. Type NM: Comply with UL 83 and UL 719.
  - 2. Type RHH and Type RHW-2: Comply with UL 44.
  - 3. Type USE-2 and Type SE: Comply with UL 854.
  - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
  - 5. Type THHN and Type THWN-2: Comply with UL 83.
  - 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 7. Type UF: Comply with UL 83 and UL 493.
  - 8. Type XHHW-2: Comply with UL 44.
- E. Shield:
  - 1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

## **2.2 ALUMINUM BUILDING WIRE**

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.
- D. Conductor Insulation:
  - 1. Type NM: Comply with UL 83 and UL 719.
  - 2. Type RHH and Type RHW-2: Comply with UL 44.
  - 3. Type USE-2 and Type SE: Comply with UL 854.
  - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
  - 5. Type THHN and Type THWN-2: Comply with UL 83.
  - 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 7. Type XHHW-2: Comply with UL 44.

## **2.3 METAL-CLAD CABLE, TYPE MC**

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. RoHS compliant.
  - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
  - 1. Single circuit and multicircuit with color-coded conductors.
  - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Ground Conductor: Bare.
- F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

G. Armor: Aluminum, interlocked.

H. Jacket: PVC applied over armor.

## **2.4 ARMORED CABLE, TYPE AC**

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Comply with UL 4.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Ground Conductor: Bare.

F. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.

G. Armor: Aluminum, interlocked.

## **2.5 PHOTOVOLTAIC CABLE, TYPE PV**

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

- D. Conductor Insulation: Comply with UL 44 and UL 4703.

## **2.6 MINERAL-INSULATED CABLE, TYPE MI**

- A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. UL 2196 for fire resistance.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper.
- D. Insulation: Compressed magnesium oxide.
- E. Sheath: Copper.

## **2.7 TRAY CABLE, TYPE TC**

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Comply with UL 1277.
  - 4. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
  - 5. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
  - 6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Ground Conductor: Bare.
- E. Conductor Insulation: Type XHHW-2. Comply with UL 44.
- F. Shield: Metallic.

## **2.8 FIRE-ALARM WIRE AND CABLE**

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size as recommended by system manufacturer.
  - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
  - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

## **2.9 CONNECTORS AND SPLICES**

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

## **PART 3 - EXECUTION**

### **3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- F. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
- G. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

- H. MC cable shall not be used for home runs unless approved prior to bid in writing by the EOR. Contractor shall notify the EOR in writing their intent to use MC cable for any application in the building prior to bidding.

### **3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.
- N. PV Circuits: Type USE-2 for PV source circuits rated at 600 V or less.
- O. PV Circuits: Type PV for PV source circuits rated at 600 V.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

### **3.4 INSTALLATION OF FIRE-ALARM WIRING**

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 27 0528.29 "Hangers and Supports for Communications Systems."
  - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
  - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
  - 1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
  - 2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
  - 3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

- G. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### **3.5 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Comply with requirements in Section 28 3111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

### **3.6 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 26 0553 "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.
- C. All conductor insulation shall be continuously colored to match phase types according to NFPA standards.

### **3.7 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 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.8 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 07 8413 "Penetration Firestopping."



### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors feeding critical equipment.
  - 3. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

**END OF SECTION**

## SECTION 26 0526

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

##### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
    - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

- 1) Test wells.
- 2) Ground rods.
- 3) Ground rings.
- 4) Grounding arrangements and connections for separately derived systems.
- 5) Photos of the grounding rod installation and footing steel connections.

b. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.

- 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- 2) Include recommended testing intervals.

## 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 MANUFACTURERS

### 2.3 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 inches wide and 1/16 inch thick.
  7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested

at 5000 V.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with socket set screw.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- K. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- M. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- N. Straps: Solid copper, copper lugs. Rated for 600 A.
- O. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.
- P. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- Q. 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.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
  - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
  - 2. Backfill Material: Electrode manufacturer's recommended material.
- C. Ground Plates: 1/4 inch thick, hot-dip galvanized.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches 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 inches minimum from wall, 6 inches 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 shall 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 shall 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 inches 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 inches above to 6 inches 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 inches 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.
  - H. Metallic Fences: Comply with requirements of IEEE C2.
    1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
    2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
    3. Barbed Wire: Strands shall be bonded to the grounding conductor.

### **3.6 FENCE GROUNDING**

- A. Fence Grounding: Install at maximum intervals of 1000 feet except as follows:
  1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
    - a. Gates and Other Fence Openings: Ground fence on each side of opening.
      - 1) Bond metal gates to gate posts.
      - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2



unless otherwise indicated.

- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

### **3.7 INSTALLATION**

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. Use exothermic welds for all below-grade connections.
  - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 0543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  - 1. Install at least one test well for 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 bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
- L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  2. Make connections with clean, bare metal at points of contact.
  3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- F. Grounding system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
  - 5. Substations and Pad-Mounted Equipment: 5 ohms.
  - 6. Manhole Grounds: 10 ohms.
- I. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

## SECTION 26 0529

### HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 26 0548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

##### 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 the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.
  - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.

3. Equipment supports.
  4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.
  2. Include design calculations for seismic restraints.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
  2. Ductwork, piping, fittings, and supports.
  3. Structural members to which hangers and supports will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

### **1.4 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
  2. AWS D1.2/D1.2M.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.5 for Emergency Generator and Emergency Lighting ATS.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing according to ASTM D635.

### **2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304.
  - 3. Channel Width: Selected for applicable load criteria.
  - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
  - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 2. Channel Material: 6063-T5 aluminum alloy.
  - 3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
  - 4. Channel Width: Selected for applicable load criteria.
  - 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c., in

at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Channel Width: Selected for applicable load criteria.
  3. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
  4. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
  5. Rated Strength: Selected to suit applicable load criteria.
  6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Stainless-steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  6. Toggle Bolts: Stainless-steel springhead type.
  7. Hanger Rods: Threaded steel.

### **2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05 5000 "Metal Fabrications" for steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA 101
  - 3. NECA 102.
  - 4. NECA 105.
  - 5. NECA 111.
- B. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor



- fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Section 05 5000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.4 CONCRETE BASES**

- A. Construct concrete bases of dimensions based on manufacturer's recommendations, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Engage a licensed structural engineer to design concrete bases for pad mounted electrical equipment. Provide signed and sealed drawings for equipment pads.
- C. Anchor equipment to concrete base as follows:
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.5 PAINTING**

- A. Touchup: 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 minimum dry film thickness of 2.0 mils.

- B. Touchup: Comply with architect's requirements for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

**END OF SECTION**

## SECTION 26 0533

### RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Nonmetal wireways and auxiliary gutters.
  - 5. Surface raceways.
  - 6. Boxes, enclosures, and cabinets.
  - 7. Handholes and boxes for exterior underground cabling.

##### 1.2 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches long.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUITS AND FITTINGS**

- A. Metal Conduit:
  - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. GRC: Comply with ANSI C80.1 and UL 6.
  - 3. ARC: Comply with ANSI C80.5 and UL 6A.
  - 4. IMC: Comply with ANSI C80.6 and UL 1242.
  - 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
    - a. Comply with NEMA RN 1.
    - b. Coating Thickness: 0.040 inch, minimum.
  - 6. EMT: Comply with ANSI C80.3 and UL 797.
  - 7. FMC: Comply with UL 1; zinc-coated steel.
  - 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
  - 1. Comply with NEMA FB 1 and UL 514B.
  - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
  - 4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  - 5. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew.
  - 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  - 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities

having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.2 NONMETALLIC CONDUITS AND FITTINGS**

- A. Nonmetallic Conduit:
1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Fiberglass:
    - a. Comply with NEMA TC 14.
    - b. Comply with UL 2515 for aboveground raceways.
    - c. Comply with UL 2420 for belowground raceways.
  3. ENT: Comply with NEMA TC 13 and UL 1653.
  4. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
  5. LFNC: Comply with UL 1660.
  6. Rigid HDPE: Comply with UL 651A.
  7. Continuous HDPE: Comply with UL 651A.
  8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
  9. RTRC: Comply with UL 2515A and NEMA TC 14.
- B. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
  2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
    - a. Fittings for LFNC: Comply with UL 514B.
  3. Solvents and Adhesives: As recommended by conduit manufacturer.

## **2.3 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Hinged type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

## **2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS**

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

## **2.5 SURFACE RACEWAYS**

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
  - 1. Material: Aluminum with clear anodized finish.
  - 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

## **2.6 BOXES, ENCLOSURES, AND CABINETS**

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

- E. Metal Floor Boxes:
  - 1. Material: Cast metal.
  - 2. Type: Fully adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
  
- G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
  - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
  
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
  
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
  
- L. Gangable boxes are allowed.
  
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Fiberglass.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
  
- N. Cabinets:
  - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as

- defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Standard: Comply with SCTE 77.
  2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
  3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  5. Cover Legend: Molded lettering, "ELECTRIC."
  6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  7. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of reinforced concrete.
1. Standard: Comply with SCTE 77.
  2. Color of Frame and Cover: Gray.
  3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  6. Cover Legend: Molded lettering, "ELECTRIC."
  7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## **2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## **PART 3 - EXECUTION**

### **3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: EMT.



3. Underground Conduit: RNC, Type EPC-80-PVC,.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
  - a. Loading dock.
  - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
  - c. Mechanical rooms.
  - d. Gymnasiums.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Z. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run

- length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- BB. 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.
- CC. 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.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 2000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 2000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 2000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade. Consult with civil engineer for frost line depth at site location.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to

be used, and seal around penetrations after fittings are installed.

### **3.5 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 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.6 FIRESTOPPING**

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 8413 "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.

**END OF SECTION**

## SECTION 26 0539

### UNDERFLOOR RACEWAYS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Flat-top, single- or multichannel, underfloor raceways.
2. Flush, flat-top underfloor raceways.
3. Cellular metal underfloor raceways.
4. Trench-type underfloor raceways.
5. Electrical connection components for precast cellular concrete floor decks.
6. Electrical connection components for electrified cellular steel floor decks.
7. Supports, raceway fittings, and hardware.
8. Junction boxes.
9. Service fittings.

B. Related Requirements:

1. Section 03 4100 "Precast Structural Concrete" for precast concrete units used as cellular concrete floor raceways.
2. Section 05 3100 "Steel Decking" for rough-in of underfloor duct distribution system.

##### 1.2 DEFINITIONS

- A. Activation: Nomenclature used by some manufacturers for a service fitting.

##### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include finishes, construction details, material descriptions, dimensions, and profiles for underfloor raceway components, fittings, and accessories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For underfloor raceways.

1. Include floor plans, elevations, sections, and details.
2. Detail fabrication and assembly of underfloor raceways.
  - a. Identify components and accessories, such as expansion-joint assemblies, straight raceway lengths, preset and afterset inserts, and service fittings.
  - b. Detail preparation and installation methods and instructions.
  - c. Provide dimensions locating raceway header and distribution elements. Include spacing between preset inserts and between preset inserts and ends of duct runs,

walls, columns, junction boxes, and header duct connections.

- d. Provide raceway fill charts for each duct size provided for each conductor size the duct is identified to accept. Provide separate charts for power and communication conductors and cables.
- e. Show connections between raceway elements and relationships between components and adjacent structural and architectural elements, including slab reinforcement, floor finish work, permanent partitions, expansion joints, architectural module lines, and pretensioning or post-tensioning components.
- f. Indicate height of preset inserts, junction boxes, and raceways coordinated with depth of concrete slab and floor fill.
- g. Indicate thickening of slabs where required for adequate encasement of raceway components.
- h. Document coordination of exposed components with floor-covering materials to ensure that fittings and trim are suitable for indicated floor-covering material.
- i. Revise locations from those indicated in the Contract Documents, as required to suit field conditions and to ensure a functioning layout. Identify proposed deviations from the Contract Documents.
- j. Show details of connections and terminations of underfloor raceways at panelboards and communication terminal equipment in equipment rooms, wire closets, and similar spaces.
- k. Identify those cells of cellular floor deck that are to be connected and fitted for the following underfloor distribution:
  - 1) Power.
  - 2) Voice.
  - 3) Data.
  - 4) Signal.
  - 5) Communications.

C. Samples: For each underfloor raceway product, in specified finish, including the following:

- 1. Service fittings and flush and recessed outlet and junction-box covers.
- 2. A section of each service raceway configuration, with specified preset insert and service fitting installed.
- 3. A junction box of each size and type for use with underfloor raceway.
- 4. A section of each header raceway configuration, complete with provisions for connection with service raceway.
- 5. A section of trench-type raceway, complete with cover and required trim.
- 6. A junction box of each size and type for use with trench-type raceway, complete with cover and trim.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For underfloor raceways, to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:



- a. Manufacturer's written instructions for locating preset inserts and for installing afterset inserts.
- B. Project Record Documents: Submit final as-built Drawings, indicating dimensioned locations for all ducts, junction boxes, and preset inserts. Typical spacing designation shall be accepted only for preset insert spacing along a continuous length of duct.

## 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. Afterset Inserts: Furnish quantity equal to 10 percent of service fittings installed, but no fewer than 5 units.
  - 2. Service Fittings: Furnish three of each type of service fitting indicated for each 100 feet of distribution raceway or active-floor-cell length.
  - 3. Outlet Blanking Covers: Furnish quantity equal to 10 percent of each type of floor opening installed for outlets, but no fewer than 20 units.
- B. Furnish one electronic instrument(s) and other tools, as recommended by underfloor raceway manufacturer for detecting, locating, and uncovering preset inserts in metal raceway under floor covering and up to 3/8 inch of concrete fill.
- C. Furnish one set(s) of tools needed for installing afterset inserts in underfloor service raceway, including the following:
  - 1. Electric Drill: Variable speed, 1/2-inch capacity.
  - 2. Hole Saw: Diamond bit, for dry concrete, 2-inch size.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Comply with UL 884.
- C. Comply with NFPA 70.
- D. Mockup: Install a mockup for evaluation of surface preparation and duct installation techniques and workmanship.
  - 1. Mockup area shall be designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, appearance, and performance are approved.
  - 3. Repair or reinstall mockup area as required to produce acceptable work.
  - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 5. Subject to compliance with requirements, approved mockups may become part of the

completed Work if undisturbed at time of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 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. Jacks, Receptacles, and Fittings:
  - 1. Comply with Section 26 2726 "Wiring Devices" for power outlets, faceplates, and connectors.
  - 2. Comply with Section 27 1513 "Communications Copper Horizontal Cabling" for twisted pair jacks, outlets, assemblies, and faceplates.
  - 3. Comply with Section 27 1523 "Communications Optical Fiber Horizontal Cabling" for optical fiber jacks, outlets, assemblies, and faceplates.
  - 4. Comply with Section 27 1533 "Communications Coaxial Horizontal Cabling" for coaxial jacks, outlets, assemblies, and faceplates.

### **2.2 FLAT-TOP, STEEL UNDERFLOOR RACEWAYS**

- A. Description: Steel, rectangular, flat-top, single-channel raceways with premanufactured inserts.
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.
- C. Material: One-piece, continuous weld, minimum 0.0598-inch-thick steel, with galvanized coating inside and out after welding.
- D. Cross-Section Shape: Rectangular, with rounded corners.
- E. Number of Longitudinal Channels: Three, separated by steel wall(s).
- F. Number of Levels: One.
- G. Minimum Bending Radius for Communication Cables: Combination of raceways, fittings, inserts, junction boxes, service fittings, and mounting and connection arrangements for wiring devices and jacks shall provide a 2-inch- minimum bending radius for communication cables.
- H. Service Raceways: Fitted with preset inserts.
  - 1. Nominal Multichannel Underfloor Raceway Dimensions:
    - a. Depth: 1-3/8 inches.
    - b. Overall Width: 10 inches.
    - c. Power Service Channel Width: 4-3/8 inches.
    - d. Communication Service Channel Width: 4 inches.
  - 2. Nominal Single-Channel Underfloor Raceway Dimensions:

- a. Depth: 1-1/2 inches.
  - b. Power Service Raceway Width: 3-1/4 inches.
  - c. Communication Service Raceway Width: 6 inches.
3. Preset Inserts: Rectangular.
- a. Spacing: 12 inches o.c.
  - b. Size: Rectangular dimensions as required to accommodate mounting and connection of flush- and surface-mounted, single- and multiple-outlet service fittings or to connect to wiring extensions for feeding wall outlets for power and communications.
  - c. Size: 2 inches in diameter.
  - d. Equip each insert with a disposable cover, and select insert height so cover is 1/8 inch below surface of concrete.
  - e. Arrange insert for optional attachment of flush-, surface-, or wiring-extension service fitting to replace disposable cover. Arrange brackets, mountings, barriers, and floor access covers to support, isolate, and provide access to flush or surface outlet-mounting connector, jack, and receptacle devices.

### 2.3 FLUSH, FLAT-TOP UNDERFLOOR RACEWAYS

- A. Description: Single or multichannel underfloor raceways installed on floor slab with top of raceway flush with concrete topping added hereafter, and then covered with finish material.
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.
- C. Description:
  - 1. Material: Steel.
  - 2. Cross-Section Shape: Rectangular, single channel and multichannel, separated by steel wall(s).
  - 3. Listed and labeled for installation with top flush with concrete floor.
  - 4. Number of Levels: One.
- D. Service Raceways: Fitted with preset inserts.
  - 1. Number of Longitudinal Channels per Multichannel Raceway: Two.
  - 2. Number of Single-Channel Raceways per Run: Two unless otherwise indicated.
  - 3. Nominal Channel Dimensions: 3 inches wide by 1-1/4 inches deep.
  - 4. Preset Inserts: Threaded opening with removable steel plug that is flush with top of raceway when screwed in place.
    - a. Spacing: 12 inches o.c., full length of each service raceway.
    - b. Arrangement: Stagger insert locations on parallel raceways or channels to accommodate placement of adjacent service fittings.
    - c. Size: 1-5/8-inch diameter.
- E. Trench Duct Crossunder: Fitting attached to underside of trench duct.
  - 1. Nominal Channel Dimensions: Same as service raceways.
  - 2. Arrangement: Offset by depth of trench duct.
  - 3. Connections: Arranged to connect trench duct to flush duct through factory-cut, grommeted openings.

- F. Header Raceways: Raceways same as service raceways, except without preset inserts (blank raceway).
  - 1. Nominal Channel Dimensions: Same as service raceways.
  - 2. Arrangement: In same plane as service raceways.
  - 3. Connections: Arranged to connect with service raceways at junction boxes.

## 2.4 CELLULAR METAL UNDERFLOOR RACEWAYS

- A. Description: Multichannel, cellular, underfloor service raceways installed on floor slab with top of raceway flush concrete topping added hereafter, and then covered with finish material.
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.
- C. Material: Galvanized-steel sheet, ASTM A653/A653M, Structural Steel (SS), Grade 33 minimum, G60 zinc coating.
- D. Material: Galvanized- and shop-primed steel sheet, ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating; with underside surface cleaned, pretreated, and primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
- E. Number of Longitudinal Cells: Three, separated by steel walls.
- F. Nominal Dimensions of Cells:
  - 1. Overall Depth: 1-1/4 inches unless otherwise indicated.
  - 2. Cross-Sectional Area of Cells: Power cells: 5-1/2 sq. in.; communication system cells: 16 sq. in..
- G. Minimum Bending Radius for Communication Cables: Combination of raceways, fittings, inserts, junction boxes, service fittings, and mounting and connection arrangements for wiring devices and jacks shall provide a 2-inch- minimum bending radius for communication cables.
- H. Service Raceways: Fitted with preset inserts.
  - 1. Preset Inserts: Rectangular-shaped metal housing assemblies arranged to provide electrical outlet access to each cell of each raceway designated for service raceway use. Inserts shall be provided throughout the entire length of each such raceway.
    - a. Spacing: 12 inches o.c.
    - b. Include housing and connecting provisions for a flush or recessed, single-, double-, or triple-outlet service fitting.
    - c. Include mounting and connecting provisions for a surface, single- or multiple-outlet service fitting.
    - d. Include connecting provisions for a wiring-extension service fitting to feed wall outlets.
    - e. Equip each insert with a disposable cover plate arranged for installation with top 1/8 inch below surface of concrete. Arrange insert to receive a flush-, recessed-, or wiring-extension service fitting to replace disposable top.
- I. Header Assembly: A junction box and raceway arrangement positioned to feed wires and cables to service raceways.

1. Three-compartment junction box connecting blank, flat-top, multichannel header raceway (no inserts) with cellular service raceways at right angles to header raceway.
2. Cellular header raceway shall be made of the same material and have the same nominal dimensions as service raceways.
3. Provide capability for service raceways to be run in both perpendicular directions at the intersection with header raceway.

## **2.5 TRENCH-TYPE UNDERFLOOR RACEWAYS**

- A. Description: Trench-type raceways used as header or feeder raceways to serve service raceways.
- B. Source Limitations: Obtain underfloor raceway components for each system through single source from single manufacturer.
- C. Trench: Steel, shop or factory welded and fabricated to indicated sizes. Include the following features:
  1. Slab Depth Adjustment: Minimum of minus 1/8 inch to plus 5/8 inch before and during concrete placement.
  2. Cover Supports: Height adjustable, with leveling screws to rigidly support cover assembly.
  3. Screed Strip: Extruded aluminum along both edges at proper elevation without requiring shim material.
  4. Trim Strip: Select to accommodate floor finish material.
  5. Partitions: Arranged to separate channels and isolate wiring of different systems.
  6. Grommeted openings in active floor cells or service raceways.
  7. Manufacturer's standard corrosion-resistant finish, applied after fabrication.
- D. Cover Plates: Removable, steel plates, 1/4 inch thick, each weighing 60 lb or less with full gasket attached to side units. Fabricate intermediate supports to limit unsupported spans to 15 inches or less. Fabricate covers with appropriate depth recess to receive indicated floor finish.

## **2.6 ELECTRICAL CONNECTION COMPONENTS FOR CELLULAR STEEL FLOOR DECK**

- A. Source Limitations for Electrified Cellular Steel Floor-Deck Components: Obtain electrical components, such as preset inserts, afterset inserts, service fittings, header ducts, and trench header ducts, from cellular steel floor-deck manufacturer.
- B. Preset Inserts: Rectangular metal-housing assemblies.
  1. Spacing: 12 inches o.c.
  2. Size: As required to provide electrical outlet access to each cell of each group of three cells that is designated for electrical service raceway use.
  3. Equip each insert with a disposable cover arranged for installation with top 1/8 inch below surface of concrete. Arrange insert to receive a flush-, recessed-, or wiring-extension service fitting to replace disposable cover.
  4. Include housing and connecting provisions for a flush or recessed service fitting, double outlet.
  5. Include connecting provisions for a wiring-extension service fitting to feed wall outlets.

## **FLOOR DECK**

- A. Source Limitations for Electrified Cellular Concrete Floor-Deck Components: Obtain electrical components, such as preset inserts, afterset inserts, service fittings, header ducts, and trench header ducts, from cellular concrete floor-deck manufacturer or from single source from single manufacturer.
- B. Afterset Inserts: Round metal-nipple assembly with internal and external threading, arranged to screw into plug driven into 1-7/8-inch hole drilled through floor fill, where present, and deck-cell wall into floor raceway cell.
  - 1. Inserts shall be compatible with floor-mounting service fittings.
  - 2. Inserts shall provide wiring path from cell to power and communication wall and ceiling outlets.
  - 3. Inserts shall provide wiring path from cell to header raceway.

## **2.8 SUPPORTS, RACEWAY FITTINGS, AND HARDWARE**

- A. Source Limitations: Obtain underfloor raceway supports, fittings, and hardware components for each system through single source from single manufacturer.
- B. Supports, fittings, and hardware shall be compatible with raceway and outlet system and shall be listed for use with raceway systems and components delivered.
- C. Supports: Adjustable for height and arranged to maintain alignment and spacing of raceways during concrete placement. Include hold-down straps.
- D. Raceway Fittings: Couplings, expansion-joint sleeves, cross-under offsets, vertical and horizontal elbows, grounding screws, adapters, end caps, and other fittings suitable for use with basic components to form a complete installation.

## **2.9 JUNCTION BOXES**

- A. Description: Raceway manufacturer's standard enclosure for indicated type, quantity, arrangement, and configuration of raceways at each raceway junction, intersection, and access location. Include the following accessories and features:
  - 1. Mounting brackets.
  - 2. Escutcheons and holders to accommodate surrounding floor covering.
  - 3. Means for leveling and height adjustment more than 3/8 inch before and after concrete is placed.
  - 4. Boxes shall withstand a minimum 300-lb concentrated load. Internal supports shall be provided as needed to meet this requirement.
  - 5. All boxes shall provide 2-inch-minimum bend radius for data and communication cables.
  - 6. Raceway Openings: For underfloor raceways and conduits arranged to accommodate raceway layout.
  - 7. Covers shall have appropriate depth recess to receive specific floor finish material.
  - 8. Partitions to separate wiring of different systems.

## 2.10 SERVICE FITTINGS/ACTIVATIONS

- A. Source Limitations: Obtain underfloor raceway service fittings and hardware for each system through single source from single manufacturer.
- B. Exposed Parts Finish: Brushed aluminum.
- C. Flush, Single-System Service Fitting for Round Inserts: Include mounting and cover to support and provide access to single connector, jack, or receptacle device; mounted flush with floor within body of insert.
  - 1. Connector, Jack, and Receptacle Devices: Single modular type.
  - 2. Power Receptacle Outlet: Suitable for 20-A, 120-V device.
- D. Flush, Single- or Multiple-System Service Fitting for Rectangular Inserts: Include mounting, hinged cover, and trim to support and provide access to connector, jack, or receptacle devices mounted flush with floor within insert.
  - 1. Connector, Jack, and Receptacle Devices: Modular type.
  - 2. Power Receptacle Rating: 20 A, 120 V unless otherwise indicated.
  - 3. Recess-Mounted Service Fitting: Modular fittings compatible with preset inserts. Include device plates for indicated systems and provisions for receptacles, jacks, and connectors. Include hinged flush covers with recessed depth to match thickness of floor finish material. Provide for internally mounted receptacle- and communication-jack and connector assemblies.
    - a. Duplex receptacle.
    - b. Duplex data jacks.
    - c. Double duplex receptacles.
    - d. Duplex receptacle and duplex data jacks.
    - e. Fiber-optic cable connector.
- E. Surface-Mounted Service Fitting: Modular pedestal type, with locking attachment matched to insert floor opening.
  - 1. Power-outlet, double-faced, surface-mounted unit for duplex receptacle on both sides.
  - 2. Power-outlet, single-faced, surface-mounted unit for duplex receptacle on one side.
  - 3. Communication-outlet, double-faced, surface-mounted unit.
    - a. Include bushed openings on both sides; 1-inch minimum diameter; insulated with nonconducting material.
    - b. Include provisions for modular dual fiber-optic connector assembly on both sides.
    - c. Include provisions for modular dual jack-connector assembly, rated for Category 6 on both sides.
  - 4. Communication-outlet, single-faced, surface-mounted unit with bushed opening on one side; 1-inch minimum diameter; insulated with nonconducting material.
  - 5. Combination surface-mounted unit for duplex receptacle on one side and with communication cable connection provision on opposite side.
    - a. Communication Side: Include bushed opening; 1-inch minimum diameter; insulated with nonconducting material.
    - b. Communication Side: Include provisions for modular dual fiber-optic connector assembly.
    - c. Communication Side: Include provisions for modular dual jack-connector

assembly, rated for Category 6.

6. Flush-Mounted Service Fittings: Modular fittings compatible with preset inserts and shall include covers, provisions for receptacles jacks and connector assemblies and wiring extensions to wall-mounted outlets, and associated device plates for indicated systems. Include flush covers, recessed to suit floor finish material.
7. Indicate types and locations of devices on Drawings.
  - a. Duplex convenience receptacle.
  - b. Duplex data outlets.
  - c. Double duplex convenience receptacles.
  - d. Duplex convenience receptacle and duplex data outlets.
  - e. Double duplex data outlets.
  - f. Duplex fiber-optic communication connector.
  - g. Wiring-Extension Service Fittings: Arrangement of brackets and mountings to support and provide access to wiring or cabling of a cell, and to connect the cable or raceway that extends the system to an individual wall outlet. Provide for connection of Type MC cable for power extensions, and ENT for communication system extensions.

### **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 raceways aligned and leveled and, unless otherwise indicated, parallel or perpendicular to floor supports.
- B. Maintain arrangement of conductor services throughout the raceway system.
- C. Install a concrete mud slab for support of cellular metal, flush duct, or trench duct raceway. Construct mud slab with wire mesh in the top 1 inch of concrete.
- D. Install a vapor barrier between the cellular metal raceway and a substrate in contact with earth.
- E. Arrange supports to attain proper elevation, alignment, and spacing of raceways. Fasten supports securely at ends and at intervals not to exceed 60 inches, to prevent movement during concrete pour.
- F. Level raceway components with finished slab and make adjustments in raceway component elevation to accommodate indicated floor finishes.
- G. Junction Boxes: Install tops level and flush with finished floor. Install blank closure plates or plugs to close unused junction-box openings. Grout boxes in place to prevent movement during construction. Place top covers in inverted position during construction to prevent damage to



surface of cover. Reinstall covers in proper position prior to final acceptance of the Work.

- H. Install preset inserts per manufacturer's instructions.
- I. Adjust supports to maintain a 1/8- to 3/8-inch finished concrete cover over preset inserts.
- J. Remove burrs, sharp edges, dents, and mechanical defects.
- K. Cap or plug boxes, insert- and service-fitting openings, and open ends of raceways.
- L. Install expansion fittings with suitable bonding jumper where raceways cross building expansion joints.
- M. Bond underfloor raceway components to create a continuous bonding path.
- N. Seal raceways, cells, junction boxes, and inserts to prevent water, concrete, or foreign matter from entering raceways before and during pouring slab or placing fill. Tape joints or seal with compound, as recommended in writing by underfloor raceway manufacturer.
- O. Install a marker at the center of the last insert of each cell and channel of each straight run of metal underfloor service raceway to locate the insert and identify the system.
  - 1. Install markers at last inserts on both sides of permanent walls and at first inserts adjacent to each junction box.
  - 2. Install markers flush at screed line before pouring slab or placing fill. Extend marker with grommets screw when floor covering is placed. Do not extend through carpet.
  - 3. Use slotted-head screw to identify electrical power; use Phillips-head screw to identify conventional communications.
  - 4. Use another distinctive screw head to identify third system, such as special-purpose wiring.
- P. Protect underfloor raceway system from damage. Do not use the installed duct system as working platforms or walkways. Do not allow equipment or heavy traffic over duct during construction period, without first installing ramps over the duct. Ramps shall be designed so that imposed loads are not transferred to the duct. Components of the system that are damaged during construction shall be replaced.
- Q. Install concrete surrounding underfloor raceways according to Section 03 3000 "Cast-in-Place Concrete."
- R. Afterset Inserts: Cut, hole saw, and drill slab and raceways to allow for installation at locations indicated on plans.
- S. Wiring shall comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" and NFPA 70 requirements for wet locations.
  - 1. Install wiring from outlet insert toward junction boxes, then to termination at panel.
  - 2. Splices: All splices and taps shall be made in junction boxes. No splices or taps shall be made in raceways or outlet inserts.

### **3.3 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform visual inspection of interior of each junction box and section of trench raceway to verify absence of dirt, dust, construction debris, and moisture. Replace damaged and malfunctioning components.
  - 2. Prior to and after concrete pour, perform point-to-point tests of ground continuity and resistance of ground path between the most remote accessible fitting on each branch of each underfloor raceway system and the main electrical distribution grounding system.
    - a. Determine cause and perform correction of any point-to-point resistance value that exceeds 0.05 ohms.
    - b. Comply with NETA Acceptance Testing Specification about safety, suitability of test equipment, test instrument calibration, and test report and records.
- D. Prepare test and inspection reports.

### **3.4 CLEANING**

- A. Clean and swab out underfloor raceways, inserts, and junction boxes after finish has been applied to floor slab, and remove foreign material, dirt, and moisture. Leave interiors clean and dry.

**END OF SECTION**

## SECTION 26 0543

### UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
  2. Rigid nonmetallic duct.
  3. Flexible nonmetallic duct.
  4. Duct accessories.
  5. Precast concrete handholes.
  6. Polymer concrete handholes and boxes with polymer concrete cover.
  7. Fiberglass handholes and boxes with polymer concrete cover.
  8. Fiberglass handholes and boxes.
  9. High-density plastic boxes.
  10. Precast manholes.
  11. Cast-in-place manholes.
  12. Utility structure accessories.

##### 1.2 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
1. Two or more ducts installed in parallel, with or without additional casing materials.
  2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include duct-bank materials, including spacers and miscellaneous components.
  2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  3. Include accessories for manholes, handholes, boxes, and other utility structures.
  4. Include underground-line warning tape.

5. Include warning planks.
- B. Shop Drawings:
1. Precast or Factory-Fabricated Underground Utility Structures:
    - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
    - b. Include duct entry provisions, including locations and duct sizes.
    - c. Include reinforcement details.
    - d. Include frame and cover design and manhole chimneys.
    - e. Include ladder details.
    - f. Include grounding details.
    - g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
    - h. Include joint details.
  2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
    - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
    - b. Include duct entry provisions, including locations and duct sizes.
    - c. Include cover design.
    - d. Include grounding details.
    - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- C. Sustainable Design Submittals:

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.
  1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
  2. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
- C. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C858.
- D. Source quality-control reports.
- E. Field quality-control reports.

#### 1.5 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

## **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

## **1.7 FIELD CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
- C. Ground Water: Assume ground-water level is 36 inches below ground surface unless a higher water table is noted on Drawings.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUIT AND FITTINGS**

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Coated Steel Conduit: PVC-coated GRC.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

### **2.2 RIGID NONMETALLIC DUCT**

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Underground Plastic Utilities Duct: Type DB-120 PVC RNC, complying with NEMA TC 6 & 8 and ASTM F512 for direct burial, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- C. Underground Plastic Utilities Duct: Type EB-20 PVC RNC, complying with NEMA TC 6 & 8, ASTM F512, and UL 651, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.

- D. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

### **2.3 DUCT ACCESSORIES**

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 26 0553 "Identification for Electrical Systems."
- C. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
  - 1. Color: Red dye added to concrete during batching.
  - 2. Mark each plank with "ELECTRIC" in 2-inch-high, 3/8-inch-deep letters.

### **2.4 PRECAST CONCRETE HANDHOLES AND BOXES**

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Comply with ASTM C858 for design and manufacturing processes.
- C. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- D. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- E. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
  - 1. Cover Hinges: Concealed, with hold-open ratchet assembly.
  - 2. Cover Handle: Recessed.
- F. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
  - 1. Cover Hinges: Concealed, with hold-open ratchet assembly.
  - 2. Cover Handle: Recessed.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC." as indicated for each service.
- I. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.

- J. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
  - 1. Extension shall provide increased depth of 12 inches.
  - 2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
  
- K. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
  
- L. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
  - 1. Center window location.
  - 2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
  - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
  - 4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  - 5. Knockout panels shall be 1-1/2 to 2 inches thick.
  
- M. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - 1. Type and size shall match fittings to duct to be terminated.
  - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
  
- N. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

**2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER**

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
  
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
  
- C. Color: Gray.
  
- D. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
  
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
  
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  
- G. Cover Legend: Molded lettering, "ELECTRIC."

- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

**2.6 FIBERGLASS HANDHOLES AND BOXES WITH POLYMER CONCRETE FRAME AND COVER**

- A. Description: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray.
- D. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "ELECTRIC."
- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

**2.7 FIBERGLASS HANDHOLES AND BOXES**

- A. Description: Molded of fiberglass-reinforced polyester resin, with covers made of reinforced concrete.
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray.
- D. Configuration: Units shall be designed for flush burial and have integral closed bottom unless



otherwise indicated.

- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "ELECTRIC."
- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## **2.8 HIGH-DENSITY PLASTIC BOXES**

- A. Description: Injection molded of HDPE or copolymer-polypropylene. Cover shall be made of polymer concrete.
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray.
- D. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "ELECTRIC."
- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## **2.9 PRECAST MANHOLES**

- A. Description: One-piece units and units with interlocking mating sections, complete with

accessories, hardware, and features.

- B. Comply with ASTM C858.
- C. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- D. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
  - 1. Center window location.
  - 2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
  - 4. Knockout panel shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  - 5. Knockout panels shall be 1-1/2 to 2 inches thick.
- E. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
  - 1. Type and size shall match fittings to duct to be terminated.
  - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
- F. Ground Rod Sleeve: Provide a 3-inch PVC sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the duct entering the structure.
- G. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## **2.10 CAST-IN-PLACE MANHOLES**

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for duct entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C858 and with Section 03 3000 "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in "Underground Enclosure Application" Article.

## **2.11 UTILITY STRUCTURE ACCESSORIES**

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A48/A48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches.
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
  2. Cover Legend: Cast in. Selected to suit system.
    - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
    - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
  3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C387, Type M, may be used.
    - b. Seal joints watertight using preformed plastic or rubber complying with ASTM C990. Install sealing material according to sealant manufacturers' written instructions.
- C. Manhole Sump Frame and Grate: ASTM A48/A48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch-diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-in and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Ground Rod Sleeve: 3-inch PVC sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the ducts routed from the facility.
- I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- J. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
1. Stanchions: T-section or channel with provisions to connect to other sections or channels

- to form a continuous unit; 1-1/2 inches in width by nominal 24 inches long; punched with 14 hook holes on 1-1/2-inch centers for cable-arm attachment.
2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
  3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.
- K. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
1. Stanchions: Nominal 36 inches high by 4 inches wide, with provisions to connect to other sections to form a continuous unit, with minimum of nine holes for arm attachment.
  2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
- L. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- M. Fixed Manhole Ladders: Arranged for attachment to wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.
- N. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches. One required.
- O. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

## **2.12 SOURCE QUALITY CONTROL**

- A. Test and inspect precast concrete utility structures according to ASTM C1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 31 1000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 31 1000 "Site Clearing."

### **3.2 UNDERGROUND DUCT APPLICATION**

- A. Duct for Electrical Cables More Than 600 V: Type EPC-80-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC RNC, concrete-encased unless otherwise indicated.
- C. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- D. Duct for Electrical Branch Circuits: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- E. Bored Underground Duct: Type EPEC-80-HDPE unless otherwise indicated.
- F. Underground Ducts Crossing Paved Paths and Driveways: Type EPC-40 PVC RNC, encased in reinforced concrete.
- G. Stub-ups: Concrete-encased GRC.

### **3.3 UNDERGROUND ENCLOSURE APPLICATION**

- A. Handholes and Boxes for 600 V and Less:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
  - 2. Cover design load shall not exceed the design load of the handhole or box.
- B. Manholes: cast-in-place concrete.
  - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium

- Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### **3.4 EARTHWORK**

- A. Refer to civil engineer drawings for earthwork details and specifications.

### **3.5 DUCT AND DUCT-BANK INSTALLATION**

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
  1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell, without reducing duct slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch.
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
  - J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
  - K. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.
  - L. Concrete-Encased Ducts and Duct Bank:
    1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 31 2000 "Earth Moving" for pipes less than 6 inches in nominal diameter.
    2. Width: Excavate trench 12 inches wider than duct on each side.
    3. Width: Excavate trench 3 inches wider than duct on each side.
    4. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
    5. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
    6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
    7. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
    8. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
    9. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
      - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
      - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
        - 1) Stub-ups shall be flush with finished floor and minimum 3 inches from conduit side to edge of slab.

- c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
  - 1) Stub-ups shall be flush with finished floor and no less than 3 inches from conduit side to edge of slab.
- 10. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
- 11. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
- 12. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
- 13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
  - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
- 14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 03 3000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

M. Direct-Buried Duct and Duct Bank:

- 1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 31 2000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
- 2. Width: Excavate trench 12 inches wider than duct on each side.
- 3. Width: Excavate trench 3 inches wider than duct on each side.
- 4. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
- 5. Set elevation of bottom of duct bank below frost line.
- 6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
- 7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
- 8. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct.
- 9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-



- up ducts throughout length of elbow.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
    - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups shall be flush with finished floor and minimum 3 inches from conduit side to edge of slab.
    - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups shall be flush with finished floor and no less than 3 inches from conduit side to edge of slab.
  11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 31 2000 "Earth Moving" for installation of backfill materials.
    - a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
    - b. Place minimum 6 inches of engineered fill above concrete encasement of duct.
  - N. Warning Planks: Bury warning planks approximately 12 inches above direct-buried duct, placing them 24 inches o.c. Align planks along the width and along the centerline of duct or duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.
  - O. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 26 0553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### **3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES**

#### **A. Cast-in-Place Manhole Installation:**

1. Finish interior surfaces with a smooth-troweled finish.
2. Knockouts for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.

- B. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C891 unless otherwise indicated.
  2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
  3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
  2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
  3. Install handholes with bottom below frost line, below grade.
  4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
  5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Damp proofing: Apply damp proofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Damp proofing materials and installation are specified in Section 07 1113 "Bituminous Damp proofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

### **3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
  - 1. Concrete: 3000 psi, 28-day strength, complying with Section 03 3000 "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: 10 inches wide by 12 inches deep.

### **3.8 GROUNDING**

- A. Ground underground ducts and utility structures according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

### **3.9 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
  - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 0526 "Grounding and Bonding for Electrical Systems."

- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

### **3.10 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
  - 1. Sweep floor, removing dirt and debris.
  - 2. Remove foreign material.

**END OF SECTION**

## SECTION 26 0544

### SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.
- B. Related Requirements:
  - 1. Section 07 8413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## **2.2 SLEEVE-SEAL SYSTEMS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or 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: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## **2.3 SLEEVE-SEAL FITTINGS**

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## **2.4 GROUT**

- A. Description: Nonshrink; recommended 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 Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

### **PART 3 - EXECUTION**

#### **3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. 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 annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 9200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 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 is to be installed or unless seismic criteria require different clearance.
  - 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 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- 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.

### **3.3 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings in new walls and slabs as they 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, seal the space around outside of sleeve-seal fittings.

**END OF SECTION**



## SECTION 26 0548.16

### SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 26 0529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

##### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
  - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.
  - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic- and Wind-Restraint Details:
  - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.

- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:
  - 1. Control and monitoring panels.
  - 2. Generators.
  - 3. Luminaires.
  - 4. Motor control centers.
  - 5. Panelboards.
  - 6. Photovoltaic system components.
  - 7. Substations.
  - 8. Switchboards.
  - 9. Switchgear.
  - 10. Transformers.
  - 11. Unit substations.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing

are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

- E. Comply with NFPA 70.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Wind-Restraint Loading:
  - 1. Minimum 10 lb/sq. ft. multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC.
  - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC.
  - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
  - 4. Design Spectral Response Acceleration at 1.0-Second Period.

### **2.2 RESTRAINT CHANNEL BRACINGS**

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

### **2.3 RESTRAINT CABLES**

- A. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

### **2.4 SEISMIC-RESTRAINT ACCESSORIES**

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## **2.5 MECHANICAL ANCHOR BOLTS**

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

## **2.6 ADHESIVE ANCHOR BOLTS**

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

# **PART 3 - EXECUTION**

## **3.1 EXAMINATION**

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for 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. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

## **3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION**

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 3000 "Cast-in-Place Concrete."

- B. Equipment and Hanger Restraints:
  - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. 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.
- E. 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.
- F. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### **3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION**

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.6 ADJUSTING**

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

**END OF SECTION**

## SECTION 26 0553

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Comply with NFPA 70E and Section 26 0573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## **2.2 COLOR AND LEGEND REQUIREMENTS**

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
  - 1. Color shall be continuous colored insulation.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 5. Color for Neutral: White.
  - 6. Color for Equipment Grounds: Green.
  - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:



1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:

1. Black letters on a white field.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
  1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
  1. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches for raceway and conductors.
    - b. 3-1/2 by 5 inches for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
  - 1. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 2. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
    - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
  - 3. Tag: Type II:
    - a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    - b. Width: 3 inches.
    - c. Thickness: 12 mils.
    - d. Weight: 36.1 lb/1000 sq. ft..
    - e. Tensile according to ASTM D882: 400 lbf and 11,500 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

## 2.7 SIGNS

- A. Baked-Enamel Signs:
  - 1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch grommets in corners for mounting.

3. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal Size: 10 by 14 inches.
- C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
  2. Thickness:
    - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    - b. For signs larger than 20 sq. in., 1/8 inch thick.
    - c. Engraved legend with black letters on white face.
    - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F.
  5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### **3.2 INSTALLATION**

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
  - 3. "UPS."
- M. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
  - 2. Limit use of underground-line warning tape to direct-buried cables.

3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

Y. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

Z. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

AA. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

BB. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals.
- D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 10-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 15 A and 100 V to Ground: Identify with self-adhesive raceway labels.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 10-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
  - 2. Label shall include circuit number and panel of origin.
- F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
  - 3. "UPS."
- G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- K. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- L. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

- M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- N. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
  - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to raceways concealed within wall.
  - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- O. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- R. Arc Flash Warning Labeling: Self-adhesive labels.
- S. Operating Instruction Signs: Self-adhesive labels.
- T. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- U. Equipment Identification Labels:
  - 1. Indoor Equipment: Self-adhesive label.
  - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
  - 3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Substations.



- h. Emergency system boxes and enclosures.
- i. Motor-control centers.
- j. Enclosed switches.
- k. Enclosed circuit breakers.
- l. Enclosed controllers.
- m. Variable-speed controllers.
- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.

**END OF SECTION**

## SECTION 26 0573.16

### COORDINATION STUDIES

#### PART 1 - GENERAL

##### 1.1 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.

##### 1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, 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."

##### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. For computer software program to be used for studies.

2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
  - a. 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 Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data:
  1. For Power System Analysis 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.

#### **1.5 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.

#### **1.6 QUALITY ASSURANCE**

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power 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. Comply with IEEE 242 and IEEE 399.
- B. 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.
- C. 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 26 0573.13 "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 Architect's attention.
  2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate 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.
  
- 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 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 26 0573.19

### ARC-FLASH HAZARD ANALYSIS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

##### 1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- 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 Systems 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 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."

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.

3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data:
  1. For Power Systems Analysis Software Developer.
  2. For Power System Analysis Specialist.
  3. For Field Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data:
  1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
  2. Operation and Maintenance Procedures: In addition to items specified in Section 01 7823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

#### **1.6 QUALITY ASSURANCE**

- A. Study 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: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
  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 in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, 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. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
  - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification 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 COMPUTER SOFTWARE DEVELOPERS**

- A. Comply with IEEE 1584 and NFPA 70E.
- B. 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.

### **2.2 ARC-FLASH STUDY REPORT CONTENT**

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 0573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 26 0573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.

- d. No AC Decrement (NACD) ratio.
- e. Equivalent impedance.
- f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
- g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

- 1. Arcing fault magnitude.
- 2. Protective device clearing time.
- 3. Duration of arc.
- 4. Arc-flash boundary.
- 5. Restricted approach boundary.
- 6. Limited approach boundary.
- 7. Working distance.
- 8. Incident energy.
- 9. Hazard risk category.
- 10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

### 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 26 0553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
  - 1. Location designation.
  - 2. Nominal voltage.
  - 3. Protection boundaries.
    - a. Arc-flash boundary.
    - b. Restricted approach boundary.
    - c. Limited approach boundary.
  - 4. Arc flash PPE category.
  - 5. Required minimum arc rating of PPE in Cal/cm squared.
  - 6. Available incident energy.
  - 7. Working distance.
  - 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### **3.2 ARC-FLASH HAZARD ANALYSIS**

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.
  - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 0573.13 "Short-Circuit Studies."
  - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 26 0573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
  - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
  - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
  - 4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
  - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
  - 1. When the circuit breaker is in a separate enclosure.
  - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### **3.3 POWER SYSTEM DATA**

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
  - 1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
  - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the 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. Obtain electrical power utility impedance or available short circuit current 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. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
  - 13. Motor horsepower and NEMA MG 1 code letter designation.
  - 14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).



15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

### **3.4 LABELING**

- A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
  1. Motor-control center.
  2. Low-voltage switchboard.
  3. Switchgear.
  4. Medium-voltage switch.
  5. Medium voltage transformers
  6. Low voltage transformers.
  7. Panelboard and safety switch over 250 V.
  8. Applicable panelboard and safety switch under 250 V.
  9. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
  1. Indicate arc-flash energy.
  2. Indicate protection level required.

### **3.5 APPLICATION OF WARNING LABELS**

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

### **3.6 DEMONSTRATION**

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

**END OF SECTION**

## SECTION 26 0923

### LIGHTING CONTROL DEVICES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching and dimming controls.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Digital timer light switches.
7. High-bay occupancy sensors.
8. Extreme temperature occupancy sensors.
9. Outdoor motion sensors.
10. Lighting contactors.
11. Emergency shunt relays.

B. Related Requirements:

1. Section 26 2726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

##### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. 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.

##### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment will be attached.
3. Items penetrating finished ceiling, including the following:

- a. Luminaires.
- b. Air outlets and inlets.
- c. Speakers.
- d. Sprinklers.
- e. Access panels.
- f. Control modules.

- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On manufacturer's website. Provide names, versions, and website addresses for locations of installed software.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### **1.5 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of lighting control software.
    - b. Faulty operation of lighting control devices.
  - 2. Warranty Period: Two year(s) from date of Substantial Completion.

### **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 as defined in NFPA 70 and marked for intended location and application.
  - 2. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
  - 3. Programs: 24 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.

4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
5. Astronomic Time: All channels.
6. Automatic daylight savings time changeover.
7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

## 2.2 ELECTROMECHANICAL DIAL-TIME SWITCHES

- A. Electromechanical-Dial Time Switches: Comply with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
  3. Astronomic time dial.
  4. Eight-Day Program: Uniquely programmable for each weekday and holidays.
  5. Skip-a-day mode.
  6. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

## 2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. General Requirements for Sensors:
1. Wall and Ceiling-mounted, solid-state indoor vacancy sensors.
  2. Dual technology.
  3. Integrated power pack.
  4. Hardwired connection to switch and lighting control system.
  5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. 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.
    - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
  8. Power: Line voltage.
  9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  10. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard 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.
  - 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  - 12. Bypass Switch: Override the "on" function in case of sensor failure.
  - 13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- B. Dual-Technology Type: Wall and Ceiling 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. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/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 square feet when mounted 48 inches above finished floor.

## 2.4 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, with provisions for connection to BAS using hardwired connection.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24 (only for projects in CA).
  - 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.
  - 4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

## 2.5 HIGH-BAY OCCUPANCY SENSORS

- A. Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
  - 3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.

4. Power: Line voltage.
  5. Operating Ambient Conditions: 32 to 149 deg F.
  6. Mounting: Threaded pipe.
  7. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  8. Detector Technology: PIR.
  9. Power and dimming control from the luminaire ballast that has been modified to include the dimming capacitor.
- B. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.
- C. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

## 2.6 EXTREME-TEMPERATURE OCCUPANCY SENSORS

- A. Description: Ceiling-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.
  2. Operation: 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 30 minutes.
  3. Operating Ambient Conditions: From minus 40 to plus 125 deg F.
  4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  5. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  6. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard 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 cover.
  7. Bypass Switch: Override the "on" function in case of sensor failure.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 10 fc; keep lighting off when selected lighting level is present.
- B. Detector Technology: PIR. Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. 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. in..
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1500 sq. ft. when mounted on a 96-inch-high ceiling.
  3. Detection Coverage (High Bay): Detect occupancy within 25 feet when mounted on a 25-foot-high ceiling.

## 2.7 OUTDOOR MOTION SENSORS

- A. Description: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
  2. Dual-technology (PIR and ultrasonic) type, weatherproof. Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
  3. Voltage: Dual voltage, 120- and 277-V type.
  4. Detector Coverage:
    - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
    - b. Long Range: 180-degree field of view and 110-foot detection range.
  5. 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.
  6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  7. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
  8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
  9. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

## 2.8 LIGHTING CONTACTORS

- A. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

## 2.9 EMERGENCY SHUNT RELAY

- A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
1. Coil Rating: 120 V.

## 2.10 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 0519 "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 SENSOR INSTALLATION**

- A. Comply with NECA 1.
- B. 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.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### **3.3 CONTACTOR INSTALLATION**

- A. Comply with NECA 1.
- B. 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 WIRING INSTALLATION**

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.



- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### **3.5 IDENTIFICATION**

- A. Identify components and power and control wiring according to Section 26 0553 "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 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.7 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.

### **3.8 SOFTWARE SERVICE AGREEMENT**

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. 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 shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### **3.9 DEMONSTRATION**

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 26 0943.16 "Addressable-Luminaire Lighting Controls" and Section 26 0943.23 "Relay-Based Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

**END OF SECTION**

## SECTION 26 0943.13

### DIGITAL-NETWORK LIGHTING CONTROLS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

##### 1.1 Section Includes:

1. Networked Central Lighting Control systems. Systems are composed of:
  - a. Network integrated power switching systems.
  - b. Network integrated dimming systems.
  - c. Standalone power switching and dimming systems.
  - d. DALI-compliant network integrated lighting controller.
  - e. Automation control processors.
  - f. Sensors
  - g. User Interfaces:
    - 1) Keypad
    - 2) Touch screen
    - 3) Virtual touch screen
2. System Functions and Sequences

##### 1.2 Related Requirements:

1. Section 26 2726 Wiring Devices
2. Section 26 5119 LED Interior Lighting

##### 1.3 REFERENCES

##### 1.4 Definitions

1. Control: Effecting a change in state by one PC program onto a microprocessor or device.
2. Scene: Predetermined light level of a single fixture or group of fixtures.
3. DALI: Digital addressable lighting interface.
4. RS-485: A serial network protocol complying with TIA-485-A.
5. UTP: Unshielded twisted pair.

##### 1.5 Reference Standards

1. California Energy Commission (CEC):
2. CEC CCR Title 24, Part 6: California Energy Efficiency Standards for Residential and Nonresidential Buildings, California's Appliance Energy Efficiency program: Listed for lighting control devices.
3. National Fire Protection Association (NFPA):
4. NFPA 70 - National Electrical Code.

5. Underwriters Laboratories (UL)
  - a. UL 508 – Industrial Control Equipment.
  - b. UL924 – Emergency Lighting and power Equipment.
  - c. UL1008 – Transfer Switch Equipment.

## 1.6 Requirements

### A. Coordination

1. Contractor shall place daylight and occupancy sensors per plans to achieve optimal performance. Proper placement shall be coordinated with others in order to avoid interference with prescribed lighting levels.
2. Contractor shall provide luminaries and lamps that are compatible with the lighting control system to be installed.
3. Contractor shall locate touch screen and keypad stations as per plans.
4. Contractor shall notify engineer of record of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

## 1.7 SYSTEM DESCRIPTION

**1.8 Web Accessible, network connected, lighting control system utilizing preset control software, central signal microprocessor, lighting control panel including integrated branch circuit protection, and power switching modules and relays, Dimming Modules, Sensors and User Interfaces.**

**1.9 System Components: System includes the following components:**

1. Keypad controls.
2. Touch screen controls.
3. Window treatment controls.
4. Remote occupancy sensors.
5. Lighting load shedding.
6. Timed room lighting.
7. Daylight compensating lighting controls.
8. Communication interface to building automation system gateway/interface.

**1.10 SUBMITTALS**

**1.11 Product Data: For each type of product required for complete network lighting control system, demonstrating compliance with requirements.**

**1.12 Shop Drawings: Indicated the following:**

1. Schematic diagram showing complete network lighting control system and accessories.
2. Circuits and emergency circuits with capacity and phase, control zones, load type and voltage per circuit.

**1.13 CLOSEOUT SUBMITTALS**

**1.14 Operating and maintenance manuals.**

**1.15 QUALITY ASSURANCE**

**1.16 Manufacturer Qualification: Manufacturer of network lighting controls with minimum [five] years record of satisfactory manufacturing and support of components comparable to basis of design system.**

**1.17 Source Requirements: Provide Network Lighting System through a single source from a single manufacturer.**

**1.18 Manufacturer Qualifications: Approved manufacturer of network lighting controls listed in this Section with minimum five years record of satisfactory manufacturing and support of components comparable to basis of design system.**

1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
  - a. Product data, including certified independent test data indicating compliance with requirements.
  - b. Samples of each component.
  - c. Sample submittal from similar project.
  - d. Project references: Minimum of 5 installations not less than 5 years old, with Owner and Architect contact information.
  - e. Sample warranty.
2. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.

B. Approved manufacturers must comply with separate requirements of Submittals Article.

**1.19 Electrical Components, Devices, and Accessories: UL listed and labeled per NFPA 70.**

**1.20 California Appliance Efficiency Listing: Provide products that comply with provisions of CEC CCR Title 24, Part 6.**

## 1.21 COORDINATION

### 1.22 Coordinate integrated lighting and dimming controls with systems and components specified in the following sections:

1. Division 26 Section "Panelboards".
2. Division 26 Section "Wiring Devices".
3. Division 26 Section "Lighting Control Devices".
4. Division 26 Section "LED Interior Lighting".

## 1.23 PROJECT CONDITIONS

### 1.24 Environmental Conditions Range:

1. Temperature: 32 – 104 deg F (0 - 40 deg C).
2. Relative Humidity: 10 – 90 percent, noncondensing.

## 1.25 WARRANTY

### 1.26 Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of modular dimming controls system the fail in materials or workmanship within the specified warranty period following substantial completion.

### 1.27 Warranty Period: Commercial lighting dimmers and switches, sensors, keypads, lighting enclosures, terminal blocks, power supplies, thermostats, and control processors, when dedicated for use as part of a commercial lighting control system: 5 year warranty

### 1.28 Manufacturer's Extended Support Service: Extended telephone support: Unlimited period.

## PART 2 EQUIPMENT

### 2.1 WIRED NETWORKED DEVICES

#### A. Wired Networked Load Controllers

1. Switched and 0-10V, ELV, MLV, 2 WIRE, 3 WIRE, DALI, DMX dimming
2. keypad control, occupancy sensing, and daylight harvesting integration
3. Real-time energy monitoring
4. Seamless integration with AV systems
5. Programmable astronomical time clock for scheduled events
6. Preloaded program for quick setup
7. Local controls for setup, testing and verification
8. Local and remote override capability
9. Optional handheld remote
  
10. Non-volatile power failure memory

#### B. Wired Networked Interfaces

1. Occupancy

- a. Dual-technology [passive infrared] motion detection
  - b. 360 degree coverage pattern
  - c. Built-in ambient light recognition
  - d. External photosensor input
  - e. Grace Occupancy feature
2. Photocell exterior
- a. Measures true color temperature and intensity of any lighting source
  - b. Enables indoor lighting to be regulated to match actual natural sunlight outdoors
  - c. IP67 rated for rooftop and other outdoor installations
  - d. Self-heating to prevent snow and ice buildup
  - e. Reports correlated color temperature (CCT) and illuminance (lux) consistent with CIE 1931
  - f. Reports RGB (Red, Green, Blue) and HSV (Hue, Saturation, Value) to recreate the detected color
  - g. Lifetime-calibrated with no drift over time or temperature
3. Photocell Interior
- a. Open or closed loop sensors
  - b. Measures the light level from a natural daylight source
  - c. 60 degree field of view
4. Keypads
- a. Field configurable combinations of 2 to 8 pushbuttons
  - b. "Split" buttons for "up/down" and "on/off" functions
  - c. "Button Events" enable tap, double-tap, and press and hold functionality
  - d. Customizable backlit button engraving
  - e. White LED feedback indicators
  - f. Built-in LED blinking and bar graph logic
  - g. Auto-dimmable backlight and LED intensity
  - h. Ambient light sensor
  - i. Dual digital/analog input ports for external sensors
5. Partition Sensor
- a. Adjustable infrared beam for high accuracy
  - b. infrared (IR) beam to sense the position of movable partitions within a space.

### **C. Wired Networked Graphic Wall Stations**

- 1. Capacitive touch screen display and backlit soft touch capacitive buttons
- 2. Voice recognition capability
- 3. H.264 or MJPEG streaming video display
- 4. Built in microphone, speakers, and 5 MP H.264 IP camera
- 5. Built-in web browsing

6. Enterprise grade security
7. Web or cloud based configuration

#### **D. Wired Networked Auxiliary Input / Output (I/O) Devices**

1. 1-8 Versiport I/O ports
2. Interface for 3rd-party sensors, detectors, contact closures, and alarms
3. Fully programmable functionality

#### **E. Wired Sensor Integration Device**

1. Works with occupancy sensors, photocells, partition sensors, and 3<sup>rd</sup> party devices
2. Includes 2 independent sensing inputs
3. supports contact-closure, DC logic, and 0-10V analog signals
4. allows fully-programmable operation

### **PART 3 - EXECUTION**

#### **3.1 FIXTURE TESTING**

A. Contractor shall provide lighting control factory test reports for each fixture specified on this project

B. Test report shall include

1. Confirmation of compatibility with control device
2. Dimming Range
3. Performance notations

#### **3.2 PLUG LOAD CONTROL**

A. Plug load controls as shown on the contract drawing shall be part of the lighting control system.

B. Plug loads shall operate in occupancy mode (Auto-on, Auto-off).

#### **3.3 ENGRAVING**

A. Keypad buttons shall be factory engraved using laser technology

B. Initial shipment of keypads shall be factory engraved per the sequence of operations specified herein and shown on the contract documents

C. Custom keypad engravings shall be provided as part of the close out procedures.



### **3.4 SYSTEM FUNCTIONS AND SEQUENCES**

A. The system shall be capable of the following lighting control functions:

1. Scene Creation: Store levels of selected fixture circuits in preset groups.
2. Scene Recall: recall previous stored scenes.
3. All zones off
4. Raise/lower level of all zones
5. Password entry for touchscreen access
6. Room/Zone selection
7. Raise/lower room shades
8. Schedule events to be automatically recalled

### **3.5 USER INTERFACE CONTROL FUNCTIONS**

A. The keypad interface shall be capable of the following system control functions:

1. Scene Recall
2. Raise/Lower
3. Off

B. Touchscreen and Virtual touch screen interfaces shall be capable of the following system control functions:

1. Password Entry
2. Multiple levels
3. Room/Zone selection
4. Scene Recall
5. Raise/Lower
6. Shade Control
7. Timeclock Events
8. Customer logo and color scheme

C. Optional control sequences for advanced control:

1. Occupancy adjustments
2. Sensor Timeout
3. Control logic (occupancy or vacancy)
4. Lighting Scenes
5. Individual zone control override
6. Timeclock adjustments
7. Modify timeclock activation schedule
8. Select/unselect pre-programmed timeclock events
9. Display all timeclock events
10. Daylight Harvesting Adjustments

11. Low end trim
12. Response time
13. Zone control
14. Scene Recall
15. Fade time
16. Color scene recall

### **3.6 TIME CLOCK EVENTS**

- A. The lighting control system shall have astronomical time clocked events. 6-time clock events shall be provided.
- B. End user shall have the option to create additional time clock events via touch screen or XPANEL interfaces.

### **3.7 INSTALLATION**

- A. Prior to installation, examine work area to verify measurements, and that commencing installation complies with manufacturer's requirements.
- B. Comply with requirements of Division 26 Sections "Common Work Results for Electrical."
- C. Do not install network power controls until space is enclosed, HVAC systems are running, and overhead and wet work in space are complete.
- D. Install network power switching controls in accordance with manufacturer's instructions.
- E. Grounding: Provide electrical grounding in accordance with NFPA 70.

### **3.8 MANUFACTURER SUPPORTED SERVICES**

#### A. Pre-wire

1. Manufacturer trained and authorized personnel shall provide on-site visit during the rough-in stage of the installation. At this time wiring topologies and terminations shall be reviewed with the Contractor.

#### B. Startup

1. Provide manufacturer's certified system startup and adjustment.
2. Switch each load on and off with manual line test feature of the power switching module before installing processors.
3. Perform operational testing to verify compliance with Specifications. Adjust as required.

#### C. Tuning

1. Within 3 months of the date of Substantial Completion provide onsite service to adjust the system to account for actual occupied conditions.

#### D. Training

1. Within 30 days, Factory authorized service representative to instruct owner's staff to adjust, operate and maintain network power switching systems; and provide instruction using the system software.
2. Demonstration: Schedule demonstration with Owner.

3. Training: Train Owner's personnel to operate, maintain, and program network power switching systems.
4. Furnish set of approved submittals, and record drawings of actual installation for Owner's personnel in attendance at training session.

**END OF SECTION**

## SECTION 26 2200

### LOW-VOLTAGE 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 and buck-boost, dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
  - 3. Include diagrams for power, signal, and control wiring.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For transformers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Qualification Data: For testing agency.
- C. Source quality-control reports.

- D. Field quality-control reports.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

### **1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. 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.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain each transformer type from single source from single manufacturer.

### **2.2 GENERAL TRANSFORMER REQUIREMENTS**

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. 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. Transformers Rated 15 kVA and Larger: Comply with NEMA TP 1 energy-efficiency levels as verified by testing according to NEMA TP 2.
- D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
- E. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed or pressure type.
  - 2. Coil Material: Copper.
- F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- G. 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, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 26 0548.16 "Seismic Controls for Electrical Systems."
- C. Cores: One leg per phase.
- D. Enclosure: Ventilated.
  - 1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound utilizing a vacuum pressure impregnation process to seal out moisture and air.
  - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
  - 1. Finish Color: Gray.
- F. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.
- 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. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.
- J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150-deg C rise above 40-deg C ambient temperature.
- K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor. Transformers serving gaming loads, heavy computer loads, or other heavy electronics loads, shall have a k-factor rating of 6 minimum.
  - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  - 2. Indicate value of K-factor on transformer nameplate.
  - 3. Unit shall meet requirements of NEMA TP 1 when tested according to NEMA TP 2 with a K-factor equal to one.
- L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  - 2. Include special terminal for grounding the shield.
- M. Neutral: Rated 200 percent of full load current for K-factor rated transformers.
- N. Wall Brackets: Wall brackets fabricated from design drawings signed and sealed by a licensed structural engineer.

- O. Fungus Proofing: Permanent fungicidal treatment for coil and core.

## 2.4 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall be listed and labeled as complying with UL 506 or UL 1561.
  - 1. Standard impedance at 60Hz: 2 percent to 5 percent (up to 10 kVA), 4 percent to 6.5 percent (above 10 kVA).
  - 2. Nameplate Rating: Linear load, 60Hz.
  - 3. Insulation Class: 220 deg C system.
  - 4. Temperature Rise: 150 deg C.
  - 5. Core Construction: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  - 6. Coil Conductors: Continuous copper windings, with terminations brazed, welded, or bolted.
  - 7. Coil Impregnation: Vacuum impregnated with polyester resin.
  - 8. Sound Level: Not exceeding values listed above for distribution transformers.
  - 9. Enclosure: Ventilated, NEMA 250, Type 3R.
  - 10. Terminations: Transformer coils shall terminate in mounting pads. Mounting lugs shall be provided on all units up to and including 270 A ratings.
  - 11. Antivibration pads or isolators shall be used between the transformer core and coil and the enclosure.
  - 12. Ground core and coil assembly to enclosure with a flexible copper grounding strap or equivalent.
  - 13. Mounting:
    - a. Ventilated Units up to 750 lb: Suitable for wall, floor, or ceiling mounting (drip plate required).
    - b. Ventilated Units over 750 lb: Suitable for floor mounting only.
    - c. Encapsulated Units up to 285 lb: Suitable for wall or floor mounting.
    - d. Encapsulated Units over 285 lb: Suitable for floor mounting only.
- B. Enclosure: Ventilated, NEMA 250, Type 3R.
  - 1. Finish Color: Gray.

## 2.5 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 0553 "Identification for Electrical Systems."

## 2.6 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
  - 2. Ratio tests at the rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at the rated voltage connections.

4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:
  - a. High-voltage to ground.
  - b. Low-voltage to ground.
  - c. High-voltage to low-voltage.
9. Temperature tests.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 26 0526 "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 from design drawings signed and sealed by a licensed structural engineer.
  1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
  2. Brace wall-mounted transformers as specified in Section 26 0548.16 "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 03 3000 "Cast-in-Place Concrete" or Section 03 3053 "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 26 0529 "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 26 0526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS for dry-type, air-cooled, low-voltage transformers. Certify compliance with test parameters.
- D. Remove and replace units that do not pass tests or inspections and retest as specified above.
- E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
  3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### **3.5 ADJUSTING**

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### **3.6 CLEANING**

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION**

## SECTION 26 2413

### SWITCHBOARDS

#### 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 and distribution switchboards rated 600 V and less.
  - 2. Surge protection devices.
  - 3. Disconnecting and overcurrent protective devices.
  - 4. Instrumentation.
  - 5. Control power.
  - 6. Accessory components and features.
  - 7. Identification.
  - 8. Mimic bus.

##### 1.3 RELATED SECTIONS

- A. Section 26 0574 "Overcurrent Protective Device Arc-Flash Study" for arc-flash study and arc-flash label requirements.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
  - 1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
  - 5. Detail utility company's metering provisions with indication of approval by utility company.
  - 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 switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
  8. Include diagram and details of proposed mimic bus.
  9. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.
- D. Delegated Design Submittal:
1. For arc-flash hazard study.
  2. For arc-flash labels.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field Quality-Control Reports:
1. Test procedures used.
  2. Test results that comply with requirements.
  3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for switchboards and all installed components.
    - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
    - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

## **1.7 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. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
  - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
  - 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
  - 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
  - 6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

## **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.
- C. Handle and prepare switchboards for installation according to NECA 400.

## **1.10 FIELD CONDITIONS**

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. Environmental Limitations:
  - 1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and 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 104 deg F.

- b. Altitude: Not exceeding 6600 feet.
- C. Unusual Service Conditions: NEMA PB 2, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- D. 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 Architect no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Owner's written permission.
  - 4. Comply with NFPA 70E.

### **1.11 COORDINATION**

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

### **1.12 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
2. 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 SWITCHBOARDS

- A. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.
- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:
  1. Main Devices: Fixed, individually mounted.
  2. Branch Devices: Panel mounted.
  3. Sections front and rear aligned.
- H. Front- and Side-Accessible Switchboards:
  1. Main Devices: Fixed, individually mounted.
  2. Branch Devices: Panel mounted.
  3. Section Alignment: Front aligned.
- I. Front- and Rear-Accessible Switchboards:
  1. Main Devices: Fixed, individually mounted.
  2. Branch Devices: Panel and fixed, individually mounted.
  3. Sections front and rear aligned.
- J. Nominal System Voltage: As indicated on the plans.
- K. Main-Bus Continuous: As indicated on the plans.
- L. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 26 0548.16 "Seismic Controls for Electrical Systems."
  1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.

- a. 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. 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."
  
- M. Indoor Enclosures: Steel, NEMA 250, Type 1.
  
- N. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
  
- O. Outdoor Enclosures: Type 3R.
  - 1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
  - 2. Enclosure: Flat roof; bolt-on rear covers rear hinged doors for each section, with provisions for padlocking.
  - 3. Doors: Personnel door at each end of aisle, minimum width of 30 inches; opening outwards; with panic hardware and provisions for padlocking. At least one door shall be sized to permit the largest single switchboard section to pass through without disassembling doors, hinges, or switchboard section.
  - 4. Accessories: LED luminaires, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack luminaire installed on wall of aisle midway between personnel doors.
  - 5. Walk-in Aisle Heating and Ventilating:
    - a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F with outside design temperature of 0 deg F.
    - b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of 100 deg F with outside design temperature of 90 deg F.
    - c. Ventilating openings complete with replaceable fiberglass air filters.
    - d. Thermostat: Single stage; wired to control heat and exhaust fan.
  
- P. Barriers: Between adjacent switchboard sections.
  
- Q. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
  
- R. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
  
- S. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
  
- T. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
  
- U. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.



- V. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
  
- W. Pull Box on Top of Switchboard:
  - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
  - 2. Set back from front to clear circuit-breaker removal mechanism.
  - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
  - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
  - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
  
- X. Buses and Connections: Three phase, four wire unless otherwise indicated.
  - 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
  - 2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
  - 3. Copper feeder circuit-breaker line connections.
  - 4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
  - 5. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
  - 6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
  - 7. Disconnect Links:
    - a. Isolate neutral bus from incoming neutral conductors.
    - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
  - 8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
  - 9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
  
- Y. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
  
- Z. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.
  
- AA. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.
  
- BB. Switchboard shall be fully rated.

## 2.3 SURGE PROTECTION DEVICES

- A. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.
- B. Features and Accessories:
  - 1. Integral disconnect switch.
  - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
  - 3. Indicator light display for protection status.
  - 4. Surge counter.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
  - 2. Line to Ground: 1200 V for 480Y/277 V or 1200 V for 208Y/120 V.
  - 3. Line to Line: 2000 V for 480Y/277 V or 1000 V for 208Y/120 V.
- E. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 700 V.
  - 2. Line to Ground: 1000 V.
  - 3. Line to Line: 1000 V.
- F. SCCR: Equal or exceed 200 kA.
- G. Nominal Rating: 20 kA.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long and short time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
  6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  8. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    - h. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
  2. Two-step, stored-energy closing.
  3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Time adjustments for long- and short-time pickup.
    - c. Ground-fault pickup level, time delay, and  $I^2t$  response.
  4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
  5. Remote trip indication and control.
  6. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 26 0913 "Electrical Power Monitoring and Control."
  7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
  2. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.

- a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
  - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
- 3. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
  - 4. Service-Rated Switches: Labeled for use as service equipment.
  - 5. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
  - 6. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  - E. Fuses are specified in Section 26 2813 "Fuses."

## 2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Control Circuits: 120-V ac, supplied from remote branch circuit.
- C. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- D. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- B. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

- C. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 26 0548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

## **2.7 IDENTIFICATION**

- A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
- B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Receive, inspect, handle, and store switchboards according to NECA 400.
  - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
  - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
  - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
  - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 3000 "Cast-in-Place Concrete."
  - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to switchboards.
  6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
  - D. Comply with mounting and anchoring requirements specified in Section 26 0548.16 "Seismic Controls for Electrical Systems."
  - E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
  - F. Install filler plates in unused spaces of panel-mounted sections.
  - G. Install overcurrent protective devices, surge protection devices, and instrumentation.
    1. Set field-adjustable switches and circuit-breaker trip ranges.
  - H. Install spare-fuse cabinet.
  - I. Comply with NECA 1.

### **3.3 CONNECTIONS**

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- B. Support and secure conductors within the switchboard according to NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

### **3.4 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. Acceptance Testing:
    - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    - b. Test continuity of each circuit.
  - 2. Test ground-fault protection of equipment for service equipment per NFPA 70.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 5. Perform the following infrared scan tests and inspections, and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    - c. Instruments and Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - 6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.6 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0573 "Overcurrent Protective Device Coordination Study."

### **3.7 PROTECTION**

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

### **3.8 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

**END OF SECTION**



## SECTION 26 2416

### 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.
  - 3. Load centers.
  - 4. Electronic-grade panelboards.

##### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.

2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

### **1.7 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. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
  3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

### **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## **1.9 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 NECA 407.

## **1.10 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.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Owner's written permission.
  - 3. Comply with NFPA 70E.

## **1.11 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
  - 1. SPD Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 0548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Height: 84 inches maximum.
  - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. 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.
  - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  - 6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 7. Finishes:
    - a. Panels and Trim: Steel and 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.
    - b. Back Boxes: Same finish as panels and trim.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- G. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

- H. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  - 5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
  - 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
  - 7. Split Bus: Vertical buses divided into individual vertical sections.
- I. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  - 4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
  - 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  - 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  - 8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
  - 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  - 1. Percentage of Future Space Capacity: 20 percent.
- L. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## **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 1.

## **2.3 POWER PANELBOARDS**

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices: Fused switches.

## **2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

## 2.5 LOAD CENTERS

- A. Load Centers: Comply with UL 67.
- B. Mains: Circuit breaker.
- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.
- E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

## 2.6 PANELBOARDS SERVING GAMES AND DATA CENTER LOADS

- A. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- C. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- D. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. SPD.
  - 1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
  - 2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
    - a. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
    - b. Line to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V.
    - c. Neutral to Ground: 1200 V for 480Y/277 or V 700 V for 208Y/120 V.
    - d. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V.
  - 3. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall 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.
  - 4. SCCR: Equal to the SCCR of the panelboard in which installed or exceed 100 kA.
  - 5. Nominal Rating: 20 kA.
- F. Buses:
  - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
  - 2. Copper equipment and isolated ground buses.

## 2.7 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. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
  6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. Subfeed Circuit Breakers: Vertically mounted.
  9. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
    - i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    - j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.



- k. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - l. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
  - m. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
  - 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 26 2813 "Fuses."
  - 2. Fused Switch Features and Accessories:
    - a. Standard ampere ratings and number of poles.
    - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

## 2.8 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: 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.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 2.9 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## **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 NECA 407.
- 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 NECA 407.
- 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 03 3000 "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 26 0548.16 "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 26 0548.16 "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 26 0553 "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 26 0553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 26 0553 "Identification for Electrical Systems" identifying source of remote circuit.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  - c. Instruments and Equipment:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0573 "Overcurrent Protective Device Coordination Study."
- 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.

### **3.6 PROTECTION**

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

**END OF SECTION**

## SECTION 26 2713

### ELECTRICITY METERING

#### 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 work to accommodate utility company revenue meters, and Owner's electricity meters used to manage the electrical power system.

##### 1.3 DEFINITIONS

- A. KY or KYZ Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity (kWh) that is based on a relay opening and closing in response to the rotation of the disk in the meter. Electronic meters generate pulses electronically.

##### 1.4 ACTION SUBMITTALS

- A. Product Data:
  - 1. For each type of meter.
  - 2. For metering infrastructure components.
- B. Shop Drawings: For electricity-metering equipment.
  - 1. Include elevation views of front panels of control and indicating devices and control stations.
  - 2. Include diagrams for power, signal, and control wiring.
  - 3. Wire Termination Diagrams and Schedules: Include diagrams for power, 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 series-combination rating data for modular meter centers with main disconnect device.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

- C. Sample Warranty: For special warranty.

## **1.6 FIELD CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Architect shall be notified and issued written permission no fewer than two days in advance of proposed interruption of electrical service.

## **1.7 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An NRTL.

## **1.8 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Damage from transient voltage surges.
  - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
  - 3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

## **1.9 COORDINATION**

- A. Electrical Service Connections:
  - 1. Coordinate with utility companies and utility-furnished components.
    - a. Comply with requirements of utility providing electrical power services.
    - b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

## **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 916.

## 2.2 UTILITY METERING INFRASTRUCTURE

- A. Install metering accessories furnished by the utility company, complying with its requirements.
- B. Utility-Furnished Meters: Connect data transmission facility of metering equipment installed by the Utility.
  - 1. Data Transmission: Transmit pulse data over control-circuit conductors, classified as Class 1 per NFPA 70, Article 725.
- C. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets:
  - 1. Comply with requirements of electrical-power utility company.
  - 2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
- E. Modular Meter Center: Factory-coordinated assembly of a main service disconnect device, wireways, meter socket modules, and feeder circuit breakers arranged in adjacent vertical sections complete with interconnecting buses.
  - 1. Comply with requirements of utility company for meter center.
    - a. Comply with UL 67.
  - 2. Housing: NEMA 250, Type 3R enclosure.
  - 3. Meter Socket Rating: Coordinated with connected feeder circuit rating.
  - 4. Minimum Short-Circuit Rating: 65,000 A symmetrical at rated voltage.
  - 5. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.
  - 6. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers and having an adjustable magnetic trip setting for circuit-breaker frame sizes of 250 A and larger. Comply with requirements in Section 26 2816 "Enclosed Switches and Circuit Breakers." Circuit breakers shall be operable from outside the enclosure to disconnect the unit. Configure cover so it can be opened only when the disconnect switch is open.
  - 7. Feeder Circuit Breakers: Series-combination-rated molded-case units, rated to protect downstream circuit breakers and to house load centers and panelboards that have 10,000-A interrupting capacity.
    - a. Identification: Complying with requirements in Section 26 0553 "Identification for Electrical Systems."
    - b. Physical Protection: Tamper resistant, with hasp for padlock.
  - 8. Surge Protection for Main Disconnect: Factory installed, integrally mounted, UL 1449 Type 1. Comply with Section 26 4313 "Surge Protection for Low-Voltage Electrical Power Circuits."
- F. Arc-Flash Warning Labels;
  - 1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 26 0574 "Overcurrent Protective Device Arc-Flash Study." Apply a 3-1/2-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.



- a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
  - 1) Location designation.
  - 2) Nominal voltage.
  - 3) Flash protection boundary.
  - 4) Hazard risk category.
  - 5) Incident energy.
  - 6) Working distance.
  - 7) Engineering report number, revision number, and issue date.

## **2.3 ELECTRICITY METERS**

- A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.
  1. Comply with ANSI C12.1 and ANSI C12.20, 0.2 accuracy class.
  2. Ambient Temperature: Minus 22 deg F to plus 158 deg F.
  3. Humidity: Zero to 95 percent, noncondensing.
- B. General Requirements for Meters:
  1. Certify that meters comply with ANSI C12.20 requirements by a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). The laboratory shall use test equipment that is certified annually and is traceable to NIST standards.
  2. Enclosure: Supplied by meter manufacturer, NEMA 250, Type 3R minimum, with provisions for locking or sealing.
  3. Identification: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."
    - a. Type: Split core, complying with recommendation of meter manufacturer.
- C. kWh Meter: Electronic single-phase and three-phase meters, measuring electricity use.
  1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
- D. Current-Transformer Cabinet: Size and configuration as recommended by metering equipment manufacturer for use with indicated connected feeder and sensors.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to switchboard installation requirements in NECA 400.

- D. Install arc-flash labels as required by NFPA 70.
- E. Wiring Method:
  - 1. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
  - 2. Minimum conduit size shall be 1-1/4 inch.

### **3.2 IDENTIFICATION**

- A. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
  - 1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
  - 2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

**END OF SECTION**

## SECTION 26 2726

### 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. Straight-blade convenience, hospital-grade, isolated-ground, and tamper-resistant receptacles.
  - 2. USB charger devices.
  - 3. GFCI receptacles.
  - 4. SPD receptacles.
  - 5. Hazardous (classified) location receptacles.
  - 6. Twist-locking receptacles.
  - 7. Pendant cord-connector devices.
  - 8. Cord and plug sets.
  - 9. Toggle switches.
  - 10. Decorator-style convenience.
  - 11. Wall switch sensor light switches with dual technology sensors.
  - 12. Wall switch sensor light switches with passive infrared sensors.
  - 13. Wall switch sensor light switches with ultrasonic sensors.
  - 14. Digital timer light switches.
  - 15. Residential devices.
  - 16. Wall-box dimmers.
  - 17. Wall plates.
  - 18. Floor service outlets.
  - 19. Poke-through assemblies.
  - 20. Prefabricated multioutlet assemblies.
  - 21. Service poles.

##### 1.3 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
  - 1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.
  - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
  - 3. Leviton: Leviton Mfg. Company, Inc.
  - 4. Pass & Seymour: Pass& Seymour/Legrand.
- 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.
- H. UTP: Unshielded twisted pair.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.
- D. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.2 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- B. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Description: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

## 2.3 USB CHARGER DEVICES

- A. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
  - 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
  - 2. USB Receptacles: Quad, Type A.
  - 3. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

## 2.4 GFCI RECEPTACLES

- A. General Description:
  - 1. 125 V, 20 A, straight blade, feed-through type, self-test type.
  - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles:
  - 1. All 15A and 20A, 125V and 250V non-locking receptacles shall be listed as "Weather Resistant" type in Damp and wet locations.
- C. Tamper-Resistant, Duplex GFCI Convenience Receptacles:

## 2.5 SPD RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.
  - 1. 125 V, 20 A, straight-blade type.
  - 2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex SPD Convenience Receptacles:

C. Isolated-Ground, Duplex SPD Convenience Receptacles:

1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

## **2.6 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES**

A. Hazardous (Classified) Locations Receptacles: Comply with NEMA FB 11 and UL 1010.

## **2.7 TWIST-LOCKING RECEPTACLES**

A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

B. Twist-Lock, Isolated-Ground, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Grounding: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

## **2.8 PENDANT CORD-CONNECTOR DEVICES**

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## **2.9 CORD AND PLUG SETS**

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## **2.10 TOGGLE SWITCHES**

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
- C. Key-Operated Switches: 120/277 V, 20 A.
  - 1. Description: Single pole, with factory-supplied key in lieu of switch handle.
- D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
- E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

## **2.11 WALL-BOX DIMMERS**

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
  - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.
- E. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

## **2.12 WALL PLATES**

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Color determined by architect.
  - 3. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
  - 4. Material for Unfinished Spaces: Galvanized steel.
  - 5. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## **2.13 POKE-THROUGH ASSEMBLIES**

### **A. Description:**

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks.
4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables.

## **2.14 WALL MOUNTED TV LOCATIONS**

### **A. Where wall mounted TVs are indication in the plans provide the following:**

1. All-in-one power and AV recessed box similar to Legrand Evolution Series.
2. Box shall include one duplex outlet, one coax cable, and one CAT6 cable.
3. Provide all accessories for a complete finish.
4. Boxes shall have a white finish

## **2.15 FINISHES**

### **A. Device Color:**

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

### **B. Wall Plate Color: For plastic covers, match device color.**

## **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 meet provisions of 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. Pigtailling 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.

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 and with grounding terminal of receptacles on top. 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-type GFCI receptacles where protection of downstream receptacles is not required.

### **3.3 IDENTIFICATION**

- A. Comply with Section 26 0553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### **3.4 FIELD QUALITY CONTROL**

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
  - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

**END OF SECTION**

## SECTION 26 2816

### 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. Receptacle switches.
  - 4. Shunt trip switches.
  - 5. Molded-case circuit breakers (MCCBs).
  - 6. Molded-case switches.
  - 7. Enclosures.

##### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

- B. 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 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

### **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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

### **1.8 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year(s) from date of Substantial Completion.

## **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. Single throw.
  - 2. Three pole.
  - 3. 600-V ac.
  - 4. 1200 A and smaller.

5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

## 2.4 NONFUSIBLE SWITCHES

- A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

## 2.5 RECEPTACLE SWITCHES

- A. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30A, 60A, or 100 A; UL 98 and NEMA KS 1; 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.
- B. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- C. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
- D. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
  - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
  - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
  - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 8. Service-Rated Switches: Labeled for use as service equipment.

## 2.6 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: 600-V ac, 30A, 60A, 100 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. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, 30A, 60A, 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power source of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
  - 1. Oiltight key switch for key-to-test function.
  - 2. Oiltight red ON pilot light.
  - 3. Isolated neutral lug; 200 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; 120-V ac coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
9. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
10. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
11. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
12. Hookstick Handle: Allows use of a hookstick to operate the handle.
13. Lugs: Mechanical type, suitable for number, size, and conductor material.
14. Service-Rated Switches: Labeled for use as service equipment.

## 2.7 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.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 167 deg F rated wire.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  1. Instantaneous trip.
  2. Long- and short-time pickup levels.
  3. Long- and short-time time adjustments.
  4. Ground-fault pickup level, time delay, and I-squared t response.

- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- N. 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. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. 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.
  - 5. Communication Capability: Circuit-breaker-mounted Integral communication module with functions and features compatible with power monitoring and control system, specified in Section 26 0913 "Electrical Power Monitoring and Control."
  - 6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
  - 8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - 9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
  - 10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - 11. Electrical Operator: Provide remote control for on, off, and reset operations.
  - 12. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

## 2.8 MOLDED-CASE SWITCHES

- A. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- B. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- C. Features and Accessories:
  - 1. Standard frame sizes and number of poles.
  - 2. Lugs:
    - a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
    - b. Lugs shall be suitable for 167 deg F rated wire.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and 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.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

## **2.9 ENCLOSURES**

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

## **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 Architect 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 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS**

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R.
  3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 with cover attached by Type 316 stainless steel bolts.

### **3.4 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 26 0548.16 "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.

### **3.5 IDENTIFICATION**

- A. Comply with requirements in Section 26 0553 "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.

### **3.6 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 for Switches:
  1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
      - 1) Use a low-resistance ohmmeter.
        - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
        - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
    - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - i. Verify correct phase barrier installation.
    - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
  2. Electrical Tests:
    - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage

in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
  - 1) Use a low-resistance ohmmeter.
    - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not

- available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
  - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  4. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

### **3.7 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 0573 "Overcurrent Protective Device Coordination Study."

**END OF SECTION**



## SECTION 26 3213

### ENGINE GENERATOR

#### PART 1 GENERAL

##### 1.1 Summary

- A This section includes the following items from a single supplier:
  - 1. Engine Generator Set.
  - 2. Enclosure
  - 3. Related Accessories as specified
  
- B Related Requirements
  - 1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
  - 2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
  - 3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
  - 4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

##### 1.2 Submittals

- A Action Submittals
  - 1. Product Data
    - a The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
  
- B Informational Submittal
  - 1. Certificates
    - a The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
  - 2. Test and Evaluation Reports

- C Closeout Submittal
  - 1. Maintenance Contracts
  - 2. Operation And Maintenance Data
  - 3. Warranty Documentation
  - 4. Record Documentation

### 1.3 Quality Assurance

- A Regulatory Agency
  - 1. The generator set shall conform to the requirements of the following codes and standards:
    - a CSA C22.2, No. 14-M91 Industrial Control Equipment.
    - b EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
    - c EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
    - d IEC8528 part 4, Control Systems for Generator Sets.
    - e IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
    - f IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
    - g NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
    - h NFPA 99, Essential Electrical Systems for Health Care Facilities.
    - i NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.
  - 2. Qualifications
    - a The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
    - b The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
  - 3. Manufacturers
    - a The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
    - b The generator set described herein are two (2) Kohler model KD800, and it is with the price of this equipment that the contractor of this section shall enter with his proposal at bid time. If the contractor wishes to propose equivalent equipment, it is to be submitted in a separate document at bid time. All additional costs associated with re-engineering and mechanical & electrical modifications to the installation will be at the contractor's expense. The contractor must also supply the details listed below with his equivalent proposal:
      - The associated credit for the equivalent equipment
      - Any deviations from the specifications in a line by line format
      - The weight & outline dimensions

Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications shall be allowed or included in the certification.

### 1.4 Warranty

- A. Manufacturer's Warranty

1. The generator set shall include a standard warranty covering three (3) years unlimited hours, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

## **PART 2 PRODUCTS**

### **2.1 Equipment**

#### **A Equipment**

1. The generator set shall be a Kohler model KD800 with a KH03450 alternator. It shall provide 1000 kVA and 800 kW when operating at 277/480 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 77 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage.

#### **B Engine**

1. The minimum 27 liter displacement engine shall deliver a minimum of 1195 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
  - a. Electronic isochronous governor capable of 0.25% steady-state frequency regulation
  - b. 24-volt positive-engagement solenoid shift-starting motor
  - c. 140-ampere automatic battery charging alternator with a solid-state voltage regulation
  - d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
  - e. Dry-type replaceable air cleaner elements for normal applications
  - f. Engine-driven or electric fuel-transfer pump including fuel filter and electric solenoid fuel shutoff valve capable of lifting fuel
  - g. The turbocharged engine shall be fueled by diesel
  - h. The engine shall have a minimum of 12 cylinders and be liquid-cooled
2. The engine shall be EPA certified from the factory
3. The generator must accept rated load in one-step.

#### **C Cooling System**

1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.

#### **D Standard Air Cleaner**

1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

#### **E Battery**

1. Each genset requires a maintenance free battery which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall comply with the NFPA requirements for engine cranking cycles. This battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 1110 amps and a minimum reserve capacity of 120 Minutes at 80F. The battery plates shall be constructed of a Calcium-Lead alloy to provide long waterless operation and extended battery life. The battery must contain a handle to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life.

2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

**F Housing**

1. Level 1 Sound Attenuated Enclosure Weather Enclosure
  - a The generator set shall be supplied with a Sound Attenuated Enclosure, providing a sound pressure of 90.4 dB(A) while the generator is operating at 100% load at 7 meters (23 feet) – free field – using acoustic insulation and acoustic-lined inlet hoods, constructed from a minimum of 0.125 inch thick formed heavy duty aluminum panels. The acoustic insulation used shall meet UL 94 HF1 flammability classification. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement. The enclosure shall use external vertical air inlet and outlet hoods with 90 degree angles to discharge air up and reduce noise. The enclosure shall have an integral rodent guard and skid end caps and shall have bracing to meet 241 kph (150 mph) wind loading.
  - b The enclosure shall have a pitched enclosure roof to prevent water accumulation, and a radiator fill panel to provide easy service access to the radiator. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement.
  - c The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion. All enclosure parts shall receive an 100% epoxy primer electrocoat (e-coat) with high-edge protection. Following the e-coat process, the parts shall be finish coated with powder baked paint for superior finish, durability, and appearance with a Power Armor™ industrial finish that provides heavy duty durability in harsh conditions, and is fade-, scratch- and corrosion-resistant.
  - d The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.
  - e Enclosures will be finished in the manufacturer's standard color.
  - f The enclosures shall allow the generator set to operate at full load in an ambient temperature of 50°C with no additional derating of the electrical output of the generator set.
  - g Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.
  - h Doors shall be fitted with hinges, hardware, and the doors shall be removable.
  - i Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.
  - j A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.
  - k The complete exhaust system shall be internal to the enclosure.
  - l The critical silencer shall be fitted with a tailpipe and rain cap.
  - m The generator set enclosure shall be furnished with two-(2) DC lights powered by the starting battery on a fused circuit with a 0-60 minute “No-Lock-On” timer.
  - n The generator set enclosure shall be furnished with the battery charger and the block heater wired into the load center.
  - o Basic Electrical Panel –The generator set enclosure shall be furnished with a load center 240VAC single phase, 200 amp max w/ main and 12 branch circuits. (1) switch control, (3) AC lights vapor tight and gasketed, and (2) duplex GFI receptacles.

**G Fuel oil storage**

1. Double Wall Secondary Containment Sub-base Fuel Tank
  - a The generator set shall be supplied with a sub-base fuel tank of sufficient capacity to hold a minimum of 24 hours of fuel at 100% loading. No less than 1749 gallons of diesel fuel.
  - b The sub-base fuel system shall be listed under UL 142, subsection entitled Special Purpose Tanks EFVT category, and will bear their mark of UL Approval according to their particular classification.

- c The above ground steel secondary containment rectangular tank for use as a sub base for diesel generators is manufactured and intended to be installed in accordance with the Flammable and Combustible Liquids Code—NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines—NFPA 37, and Emergency and Standby Power Systems—NFPA 110.
- d The primary tank shall be rectangular in shape and constructed in clam shell fashion to ensure maximum structural integrity and allow the use of a full throat fillet weld.
- e Steel Channel Support System. Reinforced steel box channel for generator support, with a load rating of 5,000 lbs. per generator mounting hole location. Full height gussets at either end of channel and at generator mounting holes shall be utilized.
- f Exterior Finish. The sub-base tank exterior finish shall be Power Armor Plus™, a polyurea-textured rubberized coating.
- g Normal venting shall be sized in accordance with the American Petroleum Institute Standard No 2000, Venting Atmospheric and Low Pressure Storage Tanks not less than 1-1/4" (3 cm.) nominal inside diameter.
- h The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than that derived from NFPA 30, table 2-8, and based on the wetted surface area of the tank. The wetted area of the tank shall be calculated on the basis of 100 percent of the primary tank. The vent is to be spring-pressure operated: opening pressure is 0.5/psig and full opening pressure is 2.5 psig. The emergency relief vent is to be sized to accommodate the total venting capacity of both normal and emergency vents.
- i There shall be a 2" NPT opening within the primary tank and lockable manual fill cap.
- j A direct reading, UL listed, magnetic fuel level gauge with a hermetically sealed, vacuum tested dial, to eliminate fogging, shall be provided.
- k A float switch for remote or local annunciation of a (50% standard) low fuel level condition shall be supplied.
- l Inner Tank Leak Alarm Kit – Includes one light, one horn remote annunciator panel, leak alarm switch and wiring. This kit is intended when the inner tank has leaked into the outer tank, thus indicating a need for a replacement tank.

#### H Controller

1. Advanced Power Management 603 (APM603) Generator Set Controller
  - a. The generator set controller shall be a microprocessor-based control system that will provide automatic starting, system monitoring, and protection.
  - b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.
2. Codes and Standards
  - a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
  - b. The controller shall meet NFPA 99 and NEC requirements.
  - c. The controller shall be UL 6200 recognized.
  - d. The controller shall meet ASTM B117 (salt spray test).
3. Applicability
  - a. The controller shall be a standard offering in the manufacturer's controller product line.
  - b. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
  - c. The controller front face shall meet an environmental rating of IP65 when mounted properly on the generator.
4. Controller Buttons, Display, and Components
  - a. The generator set controller shall include the following features and functions:
    - 1 Master Control Push Buttons – the buttons shall be tactile-feel membrane with an

indicator light to initiate the following functions:

1. Run Mode – when in Run mode the generator set shall start.
  2. Off/Reset Mode – when in Off/Reset mode, the generator set shall not accept any remote start commands and shall be capable of resetting all faults, allowing for the restarting of the generator set after a shutdown.
  3. Auto Mode – when in Auto mode, the generator set shall be ready to accept a signal from a remote device.
2. Control Panel shall include:
    1. Emergency Stop Switch – the latch type stop switch shall be red in color with a “mushroom” type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
    3. Display – the display shall be a 7.5” TFT color touchscreen.
    4. Fault Light – the controller shall have an annunciator fault light that glows red for faults and yellow for warnings. The warning light will also illuminate when not in Auto.
    5. Alarm Horn – the controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the Auto mode.
    6. Alarm Silence/Lamp Test Button – when this button is held, it shall test all controller lamps. This button will also silence the alarm horn when the unit is not Auto or has a fault.
    7. USB Connection – the controller shall have a USB connection port for a storage device that is accessible on the front of the control panel without having to open any electrical enclosure panels on the generator. This connection shall allow for updating of all software and firmware. This connection shall allow for downloading of controller parameter settings and the event log. This connection shall allow for data logging storage. This connection shall allow the ability to capture screenshots.
    8. Mini-USB Connection – the controller shall have a mini-USB connection port for a PC connection that is accessible on the front of the control panel without having to open any electrical enclosure panels on the generator. This connection shall allow a certified technician to service the generator controller using a dedicated PC program. The program shall allow for servicing of generator set parameters, faults diagnostics and viewing of controller information. The program shall allow for uploading of software and firmware as well as downloading of parameter settings and the event log.
  5. The controller shall have three user level access
    - a. User Level – no password required, and user can view all metered values and settings
    - b. Operator Level – password required to adjust settings that do not impact the generator
    - c. Technician Level – password required to adjust all settings
  6. Overview and Favorites
    - a. Overview – User shall be able to customize up to 16 gauges for a personalized Home screen that will allow for immediate access to site specific critical data.
    - b. Favorites – User shall be able to create their own menu set up with parameters for easy viewing.
  7. Load Management
    - a. Programmable outputs included to command the connect and disconnect of loads based on generator or paralleling system state:
      - 1 Under frequency
      - 2 Start up
      - 3 Generators online
      - 4 Priority demands
    - b. Supports up to 16 loads per system
      - 1 Can be used on a single generator system
      - 2 Can be combined in a paralleling system for a total system load control capability
    - c. Simplified load management system view from any generator controller in the system

- d. Load control requires the 4 input/15output module (see available options)
- 8. Controller Engine Control Features and Functions
  - a. User-programmable time delay for engine start.
  - b. User-programmable time delay engine cool down.
  - c. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time-period until engine reaches preprogrammed temperature, or as supported by ECM (Engine Control Module) equipped engine.
  - d. The idle function including engine cooldown at idle speed.
  - e. Real-time clock and calendar for time stamping of events.
  - f. Output with adjustable timer for an ether injection starting system.
  - g. Programmable cyclic cranking that can adjust on time, off time, and number of cycles.
- 9. Controller Alternator Control Features and Functions
  - a. Patented High-speed RMS Digital Voltage Regulation – the system shall have integral microprocessor-based voltage regulator system that provides +/- 0.25% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/-10% adjustable of nominal voltage.
  - b. Alternator Thermal Overload Protection – the system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
  - c. Overcurrent Protective Device– the system shall have a thermal trip, instantaneous trip and maintenance mode per NEC240.87.
- 10. Other Control Features and Functions
  - a. Event Logging – the controller keeps a record of up to 3,000 events with date and time locally for warning and shutdown faults. This event log can be downloaded onto a USB storage device or onto a PC through the service program.
    - 1 Event Snapshot – the control system shall capture 15 seconds of critical data around the time a fault or warning. This data shall be viewable on the controller and downloadable.
  - b. Data Logging – the controller shall allow customized parameters to be logged based on a start trigger from the controller interface.
    - 1 The parameters are selectable from all monitored parameters.
    - 2 The sample period shall be configurable from 1 second to 2 hours.
    - 3 The collected data shall be stored on the controller or on a USB storage device plugged into the control panel.
    - 4 The collected data shall be displayed on the screen and available for analysis.
- 11. Control Monitoring Requirements
  - a. The generator set shall have alarms and status indication lamps that show non-automatic status, warning, and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning, or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
    - 1 All monitored functions must be viewable on the control panel display
    - 2 The following generator set functions shall be monitored:
      - 1. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
      - 2. All single phase and three phase currents, 0.25% accuracy
      - 3. Output frequency, 0.25% accuracy
      - 4. Power factor by phase with leading/lagging indication
      - 5. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
      - 6. kVARS total and per phase, 0.5% accuracy
      - 7. kVA total and per phase, 0.5% accuracy
      - 8. kW hours

9. A display of percent generator set duty level (actual kW loading divided by the kW rating)
- 3 Engine parameters listed below shall be monitored: (\*are adjustable)
  1. Engine Speed\*
  2. Oil Pressure
  3. Coolant Temperature
  4. Runtime Hours
  5. Fuel Pressure
  6. Fuel Consumption Rate
- 4 Operational records shall be stored in the control beginning at system startup
  1. Total Run Time Hours
  2. Total Loaded Hours
  3. Total Unloaded Hours
  4. Total kW Hours
  5. Controller Hours
  6. Controller Run Time Hours
  7. ECM Run Time Hours
  8. Number of Starts
  9. Number of Crank Attempts
  10. Last Crank Duration
  11. Last Start Runtime Duration
  12. Last Start Time of Day
  13. Last Start Date (Day)
  14. Last Start Date (Month)
  15. Last Start Date (Year)
  16. Last Stop Time of Day
  17. Last Stop Date (Day)
  18. Last Stop Date (Month)
  19. Last Stop Date (Year)
- 5 The following operational records shall be resettable for maintenance purposes:
  1. Total Run Time Since Maintenance
  2. Loaded Hours Since Maintenance
  3. Unloaded Hours Since Maintenance
  4. kW Hours Since Maintenance
  5. Reset Maintenance Records
- 6 For maintenance and service purposes, the controller shall store and display on demand the information:
  1. Generator Model
  2. Generator Serial Number
  3. ECM Serial Number
  4. Alternator Part Number
  5. Engine Model Number
  6. Engine Serial Number
  7. Controller Serial Number
  8. Firmware Version
- 7 The controller shall support a variety of maintenance parameters including:
  1. Last Start Time o Day
  2. ScreenshotCount
  3. ECM Runtime Hours
  4. Controller Runtime Hours
  5. Last Stop Date (Month)
  6. Last Start Time of Day
  7. Last Stop Date (Day)
  8. Last Start Date (Day)
  9. Number of Starts



10. Last Stop Time of Day
  11. Last Stop Time of Day
  12. Controller Hours
  13. Number of Crank Attempts
  14. Last Crank Duration
  15. Last Start Runtime Duration
  16. Last Start Time of Day
  17. Last Start Time of Day
  18. Last Start Date (Month)
  19. Last Start Date (Year)
  20. Last Stop Time of Day
  21. Last Stop Time of Day
  22. Last Stop Date (Year)
12. Generator Set Warning, Shutdown Alarm and Status
- a. The generator set shall have alarms and status indication lamps that show Non-Automatic Status, Warning, and Shutdown conditions. The controller shall indicate with a warning lamp and/or alarm, and on the digital display screen any shutdown, warning, or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
    - 1 OverCrank Shutdown
    - 2 UnderFrequency Shutdown
    - 3 OverFrequency Shutdown
    - 4 OverPower Shutdown
    - 5 Low Oil Pressure Shutdown
    - 6 High Coolant Temperature Shutdown
    - 7 Local Emergency Stop Shutdown
    - 8 Remote Emergency Stop Shutdown
    - 9 OverSpeed Shutdown
    - 10 Loss ECM Comms Shutdown
    - 11 ECM Mismatch Shutdown
    - 12 High Oil Temperature Shutdown
    - 13 Alternator Protection Shutdown
    - 14 Protective Relay Shutdown OverPower
    - 15 Protective Relay Shutdown OverCurrent
    - 16 Protective Relay Shutdown Reverse VAR
    - 17 Protective Relay Shutdown ReversePower
    - 18 UnderVoltage Shutdown (L-L, L-N, each phase)
    - 19 OverVoltage Shutdown (L-L, L-N, each phase)
    - 20 OverCurrent Shutdown
    - 21 Excitation Overvoltage Shutdown
    - 22 Low Fuel Level Shutdown
    - 23 Low Coolant Level Shutdown
    - 24 Generator Over Power Shutdown
  - b. Conditions resulting in generator warning (generator will continue to operate):
    - 1 UnderFrequency Warning
    - 2 OverFrequency Warning
    - 3 OverPower Warning
    - 4 Low Oil Pressure Warning
    - 5 Low Coolant Temperature Warning
    - 6 High Coolant Temperature Warning
    - 7 Low Battery Voltage Warning
    - 8 High Battery Voltage Warning
    - 9 Battery Charger Fault Warning
    - 10 High Oil Temperature Warning
    - 11 GFCI Warning

- 12 UnderVoltage Warning (L-L, L-N, each phase)
- 13 Overvoltage Warning (L-L, L-N, each phase)
- 14 OverCurrent Warning
- 15 High Fuel Level Warning
- 16 Low Fuel Level Warning
- 17 Critically Low Fuel Level Warning
- 18 Generator Over Power Warning

13. Inputs and Outputs

- a. Standard Dedicated User Inputs – the controller shall have dedicated inputs for:
  - 1 Two-Wire Input
    - 1. Remote Engine Start
  - 2 Digital Input
    - 1. Auxiliary Fault (Shutdown)
    - 2. Auxiliary Warning
    - 3. Battery Charger Fault
    - 4. Breaker Close
    - 5. Breaker Trip
    - 6. Coolant Temperature
    - 7. Excitation Over Voltage
    - 8. Fuel Level
    - 9. Fuel Leak Alarm
    - 10. Low Fuel Level Switch
    - 11. Ground Fault Relay
    - 12. Remote Emergency Stop
    - 13. Local Emergency Stop
  - 3 Analog Voltage Input – Scalable Up To +- 10 VDC
    - 1. Speed Bias
    - 2. Voltage Bias
- b. Standard Dedicated User Outputs – the controller shall have dedicated inputs for:
  - 1 Relay Driver Output
    - 1. Run
    - 2. Crank
    - 3. Horn
    - 4. Common Failure
    - 5. Common Warning
    - 6. High Coolant Temperature
    - 7. Close Breaker
    - 8. Trip Breaker
- c. Optional Configurable User Inputs and Outputs
  - 1 User Configurable Inputs
    - 1. 2 Analog, 0-5 VDC
    - 2. 4 Dry Contact Digital
  - 2 User Configurable Relay Outputs
    - 1. 14 NO/NC Relays
    - 2. 1 Common Fault Relay
- d. PLC-like capability for applying logic to customize generator system behavior.

14. Communications

- a. CAN
  - 1 If the generator set engine is equipped with an ECM, the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
- b. Modbus®
  - 1 Non-isolated for RSA III
  - 2 Isolated for Modbus devices
  - 3 Isolated for paralleling communication

- 4 RJ45 for Modbus TCP, SNMP, and BACnet
  - c. Simple Network Management Protocol (SNMP)
    - 1 Industry standard SNMP communication shall be available.
    - 2 The controller shall support SNMP communication via an RJ-45 Ethernet connection.
  - d. BACnet®
    - 1 Industry standard BACnet® communication shall be available.
    - 2 The controller shall support BACnet® communication via an RJ-45 Ethernet connection.
  - e. Communication Connections
    - 1 All communication connections shall be accessible in a dedicated customer connection area that is separated from factory wiring into the controller to prevent field connections from interfering with factory wiring.
    - 2 The controller shall not require any additional hardware to support Modbus®, SNMP or BACnet® communication.
15. Paralleling
- a. The controller shall be capable of paralleling with other generators with the same controller through a dedicated communication network between the controllers and onboard paralleling capabilities.
  - b. The controller shall support paralleling up to eight generators on a common bus.
  - c. The controller shall support paralleling a single generator with utility using kW, kVAR, and Power Factor settings.
  - d. Synchronization
    - 1 The controller shall support onboard synchronization to allow matching of voltage, frequency and phase before closing a circuit breaker or contactor to connect the generator to the bus.
    - 2 The controller shall use first-on logic to determine which generator will close to the dead bus first.
    - 3 The controller shall support 3 common forms of synchronizing, Automatic (synch and close breaker), Sync-check (synch-no closure) and Permissive (no active synch, allow manual close if in synch).
    - 4 The controller shall announce a fail to synch fault when synchronization is not achieved within the programmed time delay.
    - 5 The controller shall actively maintain synchronizing efforts to achieve synchronization even after the time delay has expired.
    - 6 The controller shall be capable of actively displaying the synchronizing parameter values for both the generator and the bus when synchronizing; voltage, frequency and phase.
    - 7 The controller shall be capable of displaying the phase rotation (ABC or CBA) for both the generator and the bus and prevent closure to the bus when phase rotation does not match the generator.
  - e. Load Sharing
    - 1 The controller shall actively share real and reactive power amongst all generators on the common bus, on a per-unit or percentage basis.
    - 2 The controller shall support soft load and unload of the generator.
    - 3 The controller shall be capable of operating with droop control.
  - f. Circuit Breaker/Contactor Control
    - 1 The controller shall be capable of operating a circuit breaker or contactor to apply electricity to the parallel electrical bus.
    - 2 The controller system shall have a normally closed contact (fail safe) that will keep the breaker tripped until such conditions are met to allow closure.
    - 3 The controller system shall have a normally open contact to provide an energizing signal to close the circuit breaker.
    - 4 The controller system shall have normally open contact for control of a contactor.
    - 5 The controller will announce a Fail to Close warning when closure is not detected after 1 closure attempt.

- 6 The controller will announce a First on Fail warning when closure is not detected after 1 closure attempt when closing to a dead bus.
- 7 The controller will announce a Close Attempts Fault when the number of attempts exceeds the setting (max attempts).
- 8 The controller will monitor current to detect a failure to open the generator circuit breaker.
- 9 The controller will keep the generator running until the generator circuit breaker is seen open in order to keep the bus live to prevent other devices from closing to this bus without synchronizing.

16. Generator Management

- a. Allows the start and stop of generators based on load demand or state of other generators including:
  1. Start Power
  2. Stop Power
  3. Start Accumulator
  4. Stop Accumulator
  5. Total Online Capacity
  6. Total Available Capacity
  7. Total Bus Power
  8. Total Bus Capacity
  9. Negotiated Order
  10. Stopped by Gen Management
  11. Start Command
- b. The controller shall have a programmable disconnect point (kW) below which point the controller shall automatically trip the generator circuit breaker.

17. Protective Relays

- a. The controller shall provide a standard set of protective relay functions with programmable limits and time delays
  - 1 Over Voltage (59)
    1. User adjustable range – 100% to 130%
    2. User adjustable range time delay – 0 to 120 seconds
  - 2 Under Voltage (27)
    1. User adjustable range – 70% to 100%
    2. User adjustable time delay – 0 to 120 seconds
  - 3 Over Frequency (81O)
    1. User adjustable range – 100% to 140%
    2. User adjustable time delay – 0 to 120 seconds
  - 4 Reverse Power (32R)
    1. User adjustable range – 0% to 50%
    2. User adjustable time delay – 0 to 120 seconds
  - 5 Over Power (32O)
    1. User adjustable range – 90% to 150%
    2. User adjustable time delay – 0 to 120 seconds
  - 6 Loss of Field (40 Reverse VARS)
    1. User adjustable range – 10% to 100%
    2. User adjustable time delays – 0 to 120 seconds
  - 7 Over Current with Voltage Range
    1. User adjustable range – 100% to 200%
    2. User adjustable time delay – 0 to 120 seconds

I Generator Overcurrent and Fault Protection

1. The generator shall be provided with a factory installed, 100% rated line circuit breaker rated at 1200 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.

2. The circuit breaker(s) shall incorporate a motor operated electronic trip unit.
3. Load side lugs shall be provided from the factory. The line circuit breaker shall include shunt trip. Load side breaker connections made at the factory shall be separated from field connections.
4. The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.
5. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the other generator-set alarms.
6. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

**J Alternator**

1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 3136 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

**K Vibration Isolation**

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

**2.2 Accessories**

- A. The generator set shall be supplied with a 20-ampere automatic float/equalize battery charger capable of charging both lead-acid and ni-cad type batteries, with the following features:
  - i. Automatic 3-stage float to equalization charge
  - ii. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
  - iii. Battery charging current Ammeter and battery voltage voltmeter with 5% full-scale accuracy
  - iv. LED lamp for power ON indication
  - v. Current limited during engine cranking, short circuit, and reverse polarity conditions
  - vi. Temperature compensated for ambient temperatures for -40°C to 60°C
  - vii. Alarm circuit board featuring alarm contacts for low battery voltage, high battery voltage, and battery charger malfunction.
  - viii. UL 1012 Listed
  - ix. CSA Certified
- B. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

- C. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
- D. The generator shall be furnished with an externally mounted, recessed, emergency stop switch (break glass, pushbutton style) protected from accidental operation.
- E. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows and includes the flex exhaust tube and the mounting hardware.
- F. Block Heater - The block heater shall be thermostatically controlled, 6000 watt, 240 VAC - single phase, to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
- G. Supply flexible fuel lines to provide a flexible connection between the engine fuel fittings and the fuel supply tank piping and for the fuel return lines from the injector pump per engine manufacturer's recommendations. Flex line shall have a protective steel wire braid to protect the hose from abrasion.
- H. Remote annunciator panel – The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.

### 2.3 Source Quality Control

#### A. Non-Conforming Work

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
  - a. **Design Prototype Tests.** Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
    - i. Maximum power (kW)
    - ii. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
    - iii. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
    - iv. Governor speed regulation under steady-state and transient conditions.
    - v. Voltage regulation and generator transient response.
    - vi. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
    - vii. Three-phase short circuit tests.
    - viii. Alternator cooling air flow.
    - ix. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
    - x. Endurance testing.
  - b. **Final Production Tests.** Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
    - i. Single-step load pickup
    - ii. Safety shutdown device testing
    - iii. Rated Power @ 0.8 PF
    - iv. Maximum power
    - v. Upon request, a witness test, or a certified test record sent prior to shipment.
  - c. **Site Tests.** The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
    - i. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions

- present and expected.
- ii. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
  - iii. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
  - iv. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
  - v. NFPA 110 Testing. The test shall consist of 2 hours of continuous operation at 100% load using a portable resistive load bank and 1.5 hours of building load. Furnish the portable load bank, all connecting cables, metering equipment, and other equipment or devices required to perform the on-site testing. During the test, readings shall be taken every 15 minutes showing % load, voltage, amps, oil pressure, water temperature, and battery charge.

**END OF SECTION**

## SECTION 26 3223

### AUTOMATIC TRANSFER SWITCH

#### PART 1 GENERAL

##### 1.1 Summary

- A This section includes the following items from a single supplier:
  - 1. Automatic transfer switch
  - 2. Related Accessories as specified
  
- B Related Requirements
  - 1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
  - 2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been omitted or have been taken exception to, and a complete description of all deviations.
  - 3. It is the intent of this specification to secure an automatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
  - 4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

##### 1.2 Submittals

- A Action Submittals
  - 1. Product Data
    - a The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.
  
- B Closeout Submittals
  - 1. Operation And Maintenance Data
  - 2. Warranty Documentation

##### 1.3 Quality Assurance

- A Regulatory Agency
  - 1. The automatic transfer switch shall conform to the requirements of the following codes and standards:
    - a UL 1008 - Standard for Transfer Switch Equipment



- b IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  - c NFPA 70 - National Electrical Code
  - d NFPA 99 - Essential Electrical Systems for Health Care Facilities
  - e NFPA 110 - Emergency and Standby Power Systems
  - f IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
  - g NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.
  - h EN61000-4-4 Fast Transient Immunity Severity Level 4
  - i EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)
  - j IEEE 472 (ANSI C37.90A) Ring Wave Test
  - k IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)
  - l CSA C22.2 No. 178 certification
2. Qualifications
- a The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
  - b A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year shall produce the automatic transfer switch.
3. Manufacturers
- a The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
  - b The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
  - c The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

#### 1.4 Warranty or Bond

- A Manufacturer's Warranty
- 1. The ATS shall include a standard warranty covering one (1) year to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
  - 2. The ATS manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

## PART 2 PRODUCTS

### 2.1 Equipment

- A Equipment
- 1. Furnish and install two automatic transfer switches. One being 3-Pole 4-Wire, Solid Neutral 2000 Amps, 480V/60Hz and the second being 3-Pole 4-Wire, Solid Neutral 200 Amps, 480V/60Hz

Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

**B Manufacturer**

1. Automatic transfer switches shall be Kohler Standard Transition KCS-AMTC-2000S and KSS-AMTC-0200S. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid date. Alternate bids shall include a line-by-line clarification of the specification marked with "D" for deviation; "E" for exception, and "C" for comply.

**C Construction**

1. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism.
2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
3. The switch shall be positively locked and unaffected by momentarily outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amperes and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
7. For two and three pole switches, where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.
8. For four pole switches with a switching neutral, where neutral conductors must be switched as shown on the plans, the contactor shall be provided with fully rated switched neutral transfer contacts. Overlapping neutral contacts may be used as an alternative.

**D Enclosure**

3. The ATS shall be furnished in a NEMA 3R enclosure.
4. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

## **2.2 Operation**

**A Controls**

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
  - a Nominal line voltage and frequency
  - b Single or three phase sensing

- c Operating parameter protection
- d Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

**B Voltage and Frequency**

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored. Voltage on both normal and emergency sources and frequency on the emergency sources shall be adjustable with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):
 

a	Parameter	Dropout/Trip	Pickup/Reset
b	Under voltage	75 to 98%	85 to 100%
c	Over voltage	06 to 135%	95 to 100% of trip
d	Under frequency	95 to 99%	80 to 95%
e	Over frequency	01 to 115%	105 to 120%
f	Voltage unbalance	5 to 20%	3 to 18%
2. Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of -20°C to 70°C.
3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.
6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

**C Time Delays**

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.
2. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect and reconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.
6. All time delays shall be adjustable in 1 second increments.
7. All time delays shall be adjustable by using the display and keypad, with a remote device connected to the communications interface port or USB.
8. Each time delay shall be identified and a dynamic countdown shall be shown on the display. Active time delays can be viewed with a remote device connected to the communications

interface port or USB.

D Additional Features

1. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.
2. The display shall provide for the test functions, allowed through password security. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.
3. A contact closure shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
4. Auxiliary contacts shall be provided consisting of a minimum of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
5. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
6. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.
7. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
8. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad, communications interface port or USB. A "not-in-auto" LED shall indicate anytime the controller is inhibiting transfer from occurring.
10. An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled from the user interface, communications interface port or USB.
11. A time based load control feature shall be available to allow the prioritized addition and removal of loads based during transfer. This feature may be enabled for either or both sources. The user shall be able to control up to nine loads with independent timing sequences for pre and post transfer delays in either direction of transfer.
12. The controller shall provide 2 inputs for external controls that can be programmed from the following values:
  - a Common fault, Remote test, Inhibit transfer, Low battery voltage, Peak shave, Time delay bypass, Load shed forced to OFF position (Programmed transition only)
13. The controller shall provide two form "C" contact outputs rated for up to 12A @ 240VAC or 2A @ 480VAC that can be programmed from the following values:
  - a Aux switch open, Transfer switch aux contact fault, Alarm silenced, Alarm active, I/O communication loss, Contactor position, Exercise active, Test mode active, Fail to transfer, Fail to acquire standby source, Source available, Phase rotation error, Not in automatic mode, Common alarm, In phase monitor sync, Load bank control active, Load control active, Maintenance mode active, Non-emergency transfer, Fail to open/close, Loss of phase, Over/under voltage,

- Over/under frequency, Voltage unbalance, Start signal, Peak shave active, Preferred source supplying load, Standby source supplying load
14. The controller shall be capable of expanding the number of inputs and outputs with additional modules.
  15. Optional input/output modules shall be furnished which mount on the inside of the enclosure to facilitate ease of connections.
  16. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
    - a Enable or disable the routine
    - b Enable or disable transfer of the load during routine.
    - c Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every)
    - d Set the duration of the run.
    - e At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be display when the exercise is active. It shall be possible of ending the exercise event with a single button push.
  17. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.
  18. System Status - The controller shall have a default display the following on:
    - a System status
    - b Date, time and type of the next exercise event
    - c Average voltage of the preferred and standby sources
    - d Scrolling through the displays shall indicate the following:
      - i) Line to line and line to neutral voltages for both sources
      - ii) Frequency of each source
      - iii) Load current for each phase
      - iv) Single or three phase operation
      - v) Type of transition
      - vi) Preferred source
      - vii) Commit or no commit modes of operation
      - viii) Source/source mode
      - ix) In phase monitor enable/disable
      - x) Phase rotation
      - xi) Date and time
  19. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
  20. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
  21. Communications Interface - The controller shall be capable of interfacing, through a standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration). This module shall allow for seamless integration of existing or new communication transfer devices and generators.
  22. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.
  23. The controller shall contain a USB port for use with a software diagnostic application available to factory authorized personnel for downloading the controller's parameters and settings; exercise

- event schedules; maintenance records and event history. The application can also adjust parameters on the controller.
24. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be accessible via the communications interface port or USB.
- a Event Logging
    - i) Data, date and time indication of any event
  - b Statistical Data
    - i) Total number of transfers\*
    - ii) Total number of fail to transfers\*
    - iii) Total number of transfers due to preferred source failure\*
    - iv) Total number of minutes of operation\*
    - v) Total number of minutes in the standby source\*
    - vi) Total number of minutes not in the preferred source\*
    - vii) Normal to emergency transfer time
    - viii) Emergency to normal transfer time
    - ix) System start date
    - x) Last maintenance date
    - xi) \* The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.
25. External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

### 2.3 Accessories

- A. Padlockable User Interface Cover. The user interface cover shall protect the controller user interface from the environment.
- B. Controller Disconnect Switch. A Logic disconnect switch shall be mounted inside the enclosure, and shall disconnect power to controller without disconnecting the load. The logic disconnect switch shall disconnect utility power to the controller during maintenance and service without disconnecting power to the load. The switch has two positions, auto and disconnect. The disconnect position shall disconnect the voltage sensing leads for the utility source (A, B, C, N). It is assumed that the user shall disable the generator by placing the controller in the OFF position.
- C. Line to Neutral Monitoring. Line-to-neutral voltage monitoring shall allow the display of the AN, BN, and CN RMS voltages in the normal operation menus.

### 2.4 Source Quality Control

- A Test and Inspection
  - 1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
  - 2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

**END OF SECTION**

## SECTION 26 4313

### SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

#### 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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:
  - 1. Section 26 2413 "Switchboards" for factory-installed SPDs.
  - 2. Section 26 2416 "Panelboards" for factory-installed SPDs.

##### 1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for

VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special warranty.

### **1.6 CLOSEOUT SUBMITTALS**

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

### **1.7 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL SPD REQUIREMENTS**

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

### **2.2 SERVICE ENTRANCE SUPPRESSOR**

- A. SPDs: Comply with UL 1449, Type 1.
- B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1
  - 1. SPDs with the following features and accessories:
    - a. Integral disconnect switch.
    - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
    - c. Indicator light display for protection status.
    - d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally



closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

- e. Surge counter.
- C. Comply with UL 1283.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
  - 2. Line to Ground: 1200 V for 480Y/277 V and 1200 V for 208Y/120 V.
  - 3. Line to Line: 2000 V for 480Y/277 V and 1000 V for 208Y/120 V.
- F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 700 V.
  - 2. Line to Ground: 700 V.
  - 3. Line to Line: 1000 V.
- G. SCCR: Equal or exceed 200 kA.
- H. Inominal Rating: 20 kA.

## 2.3 PANEL SUPPRESSORS

- A. SPDs: Comply with UL 1449, Type 1.
  - 1. Include LED indicator lights for power and protection status.
  - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
  - 3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- C. Comply with UL 1283.
- D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
  - 2. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.

3. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
  4. Line to Line: 2000 V for 480Y/277 V and 1200 V for 208Y/120 V
- E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
  2. Line to Ground: 700 V.
  3. Neutral to Ground: 700 V.
  4. Line to Line: 1200 V.
- F. SCCR: Equal or exceed 200 kA.
- G. Inominal Rating: 20 kA.

## **2.4 ENCLOSURES**

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

## **2.5 CONDUCTORS AND CABLES**

- A. Power Wiring: Same size as SPD leads, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.2 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  2. Inspect anchorage, alignment, grounding, and clearances.
  3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.3 STARTUP SERVICE**

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

**END OF SECTION**

## SECTION 26 5119

### 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 the following types of LED luminaires:
  - 1. Cylinder.
  - 2. Downlight.
  - 3. Highbay, linear.
  - 4. Linear industrial.
  - 5. Lowbay.
  - 6. Parking garage.
  - 7. Recessed linear.
  - 8. Strip light.
  - 9. Surface mount, linear.
  - 10. Surface mount, nonlinear.
  - 11. Suspended, linear.
  - 12. Suspended, nonlinear.
  - 13. Materials.
  - 14. Finishes.
  - 15. Luminaire support.
- B. Related Requirements:
  - 1. Section 26 0923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

##### 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.
  - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. 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.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
  - 1. Include Samples of luminaires and accessories involving color and finish selection.
- E. Samples for Verification: For each type of luminaire.
  - 1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule: For luminaires and lamps.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Luminaires.
  - 2. Suspended ceiling components.
  - 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.

4. Structural members to which **equipment and or** luminaires will be attached.
  5. Initial access modules for acoustical tile, including size and locations.
  6. Items penetrating finished ceiling, including the following:
    - a. Other luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Ceiling-mounted projectors.
  7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Product Certificates: For each type of luminaire.
- F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- G. Sample warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
  - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 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.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: **Five** year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to **ASCE 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 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. Standards:
  - 1. ENERGY STAR certified.
  - 2. California Title 24 compliant.
  - 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
  - 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
  - 5. UL Listing: Listed for damp location.
  - 6. Recessed luminaires shall comply with NEMA LE 4.
  - 7. User Replaceable Lamps:
    - a. Bulb shape complying with ANSI C78.79.
    - b. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- C. CRI of minimum of 80. CCT as specified on drawings.
- D. Rated lamp life of 50,000 hours to L90.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.
- G. Nominal Operating Voltage: 120 V ac.
  - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- H. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. Powder-coat finish.

## 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. 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.
- C. Diffusers and Globes:
  - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.



3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. 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 for all luminaires.

## **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.

## **2.5 LUMINAIRE SUPPORT**

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## **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. 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 vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaire Support:
  - 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 Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
  - 2. Ceiling mount with pendant mount
  - 3. Ceiling mount with hook mount.
- H. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. 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.
  - 3. 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.
  - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- I. 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.

- J. Comply with requirements in Section 26 0519 "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 26 0553 "Identification for Electrical Systems."

### **3.5 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

- A. Comply with requirements for startup specified in Section 26 0943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 26 0943.23 "Relay-Based Lighting Controls."

### **3.7 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 26 5619**  
**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 SUMMARY**

- A. Section Includes:
  - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.
  - 3. Luminaire-mounted photoelectric relays.
- B. Related Requirements:
  - 1. Section 26 0923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

**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. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

5. Photometric data and adjustment factors based on laboratory tests, complying with **IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 IES LM-80.**
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  6. Wiring diagrams for power, control, and signal wiring.
  7. Photoelectric relays.
  8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. 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.
- C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- D. Product Schedule: For luminaires and lamps. **Use same designations indicated on Drawings.**
- E. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports **and seismic restraints.**

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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. Luminaires.
  2. Structural members to which **equipment and** luminaires will be attached.
  3. Underground utilities and structures.
  4. Existing underground utilities and structures.
  5. Above-grade utilities and structures.
  6. Existing above-grade utilities and structures.
  7. Building features.
  8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
1. Luminaire.
  2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by a **qualified testing agency**.
- F. Source quality-control reports.
- G. Sample warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires **and photoelectric relays** to include in operation and maintenance manuals.
1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
  2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

## 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. Lamps: **Ten for every 100** of each type and rating installed. Furnish at least one of each type.
  2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: **One for every 100** of each type and rating installed. Furnish at least one of each type.
  3. Diffusers and Lenses: **One for every 100** of each type and rating installed. Furnish at least one of each type.
  4. Globes and Guards: **One for every 20** of each type and rating installed. Furnish at least one of each type.

## 1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- F. Mockups: For exterior luminaires, complete with power and control connections.
  - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
  - 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.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

### **1.10 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.

### **1.11 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: **5** year(s) from date of Substantial Completion.

## **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 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 **and listed for wet location.**
- E. Lamp base complying with **ANSI C81.61 or IEC 60061-1.**
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of **80**. CCT as specified on drawings.
- H. L70 lamp life of **50,000** hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: **120 V ac** or **208 V ac**.
- L. Lamp Rating: Lamp marked for **outdoor use and in enclosed locations.**
- M. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- N. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

## 2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at **1.5 to 3 fc** and off at **4.5 to 10 fc** with 15-second minimum time delay.
  1. Relay with locking-type receptacle shall comply with ANSI C136.10.
  2. Adjustable window slide for adjusting on-off set points.

## 2.4 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.



- B. Sheet Metal Components: **Corrosion-resistant aluminum**. Form and support to prevent warping and sagging.
- C. 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. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least **0.125 inch** minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. 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.
- G. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located 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 for all luminaires.

## 2.5 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. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
  4. 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: Verify with Architect.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
    - a. Color: As selected from manufacturer's standard catalog of colors.
    - b. Color: Match Architect's sample of **manufacturer's standard** or **custom** color.
    - c. Color: As selected by Architect from manufacturer's full range.

## 2.6 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## 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, **and canopy ceilings and 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.**
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. **Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.**
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. **Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.**
- K. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 0533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### 3.4 BOLLARD LUMINAIRE INSTALLATION:

- A. Align units for optimum directional alignment of light distribution.
  - 1. Install on concrete base with top **4 inches** above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 3000 "Cast-in-Place Concrete."

### **3.5 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 03 3000 "Cast-in-Place Concrete."

### **3.6 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 26 0533 "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.

### **3.7 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

### **3.8 FIELD QUALITY CONTROL**

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
    - a. IES LM-5.
    - b. IES LM-50.
    - c. IES LM-52.
    - d. IES LM-64.
    - e. IES LM-72.
  - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.9 DEMONSTRATION**

- A. **Train** Owner's maintenance personnel to adjust, operate, and maintain luminaires **and photocell relays**.

### **3.10 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**